APRIL 14, 1945

Electrical World

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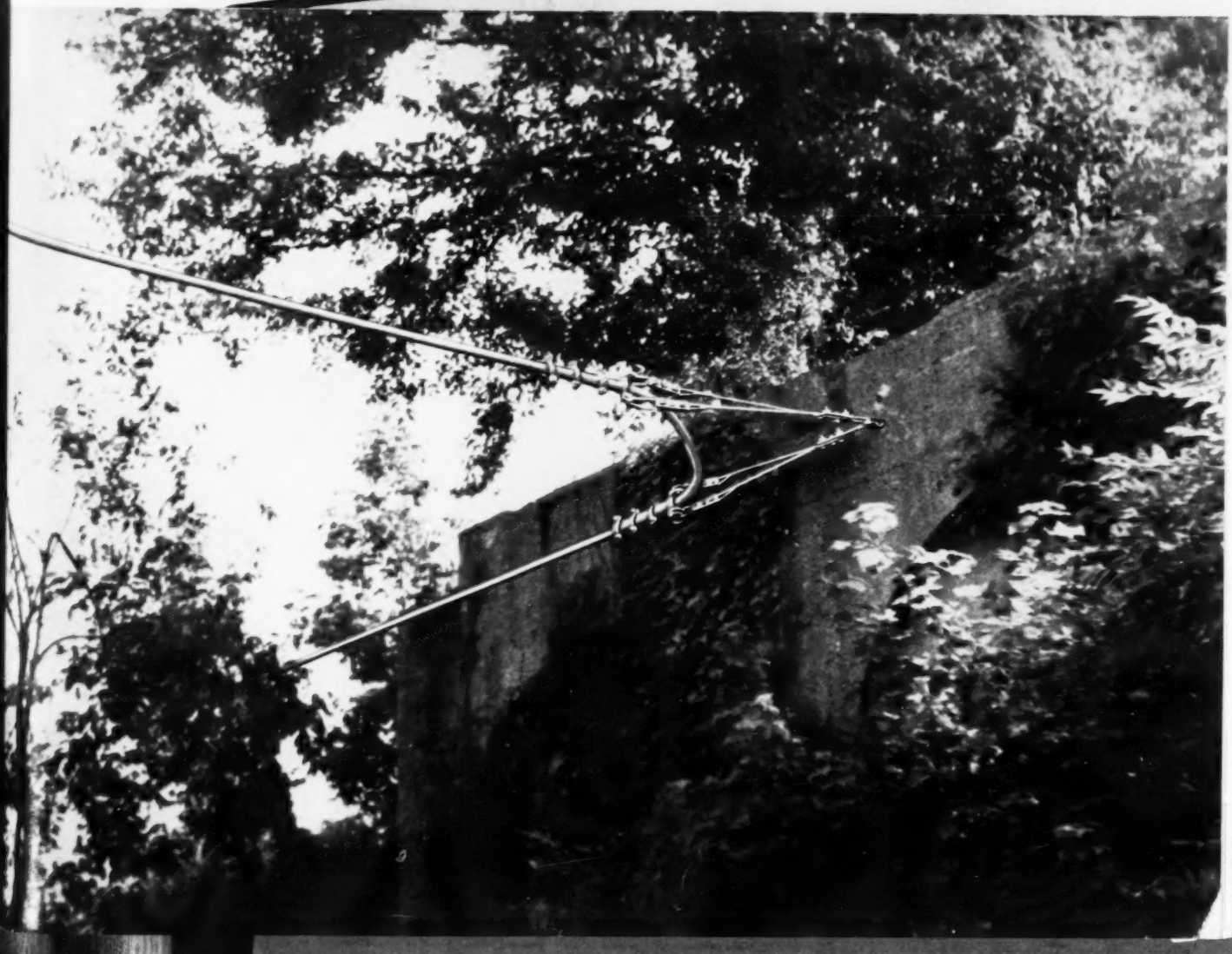
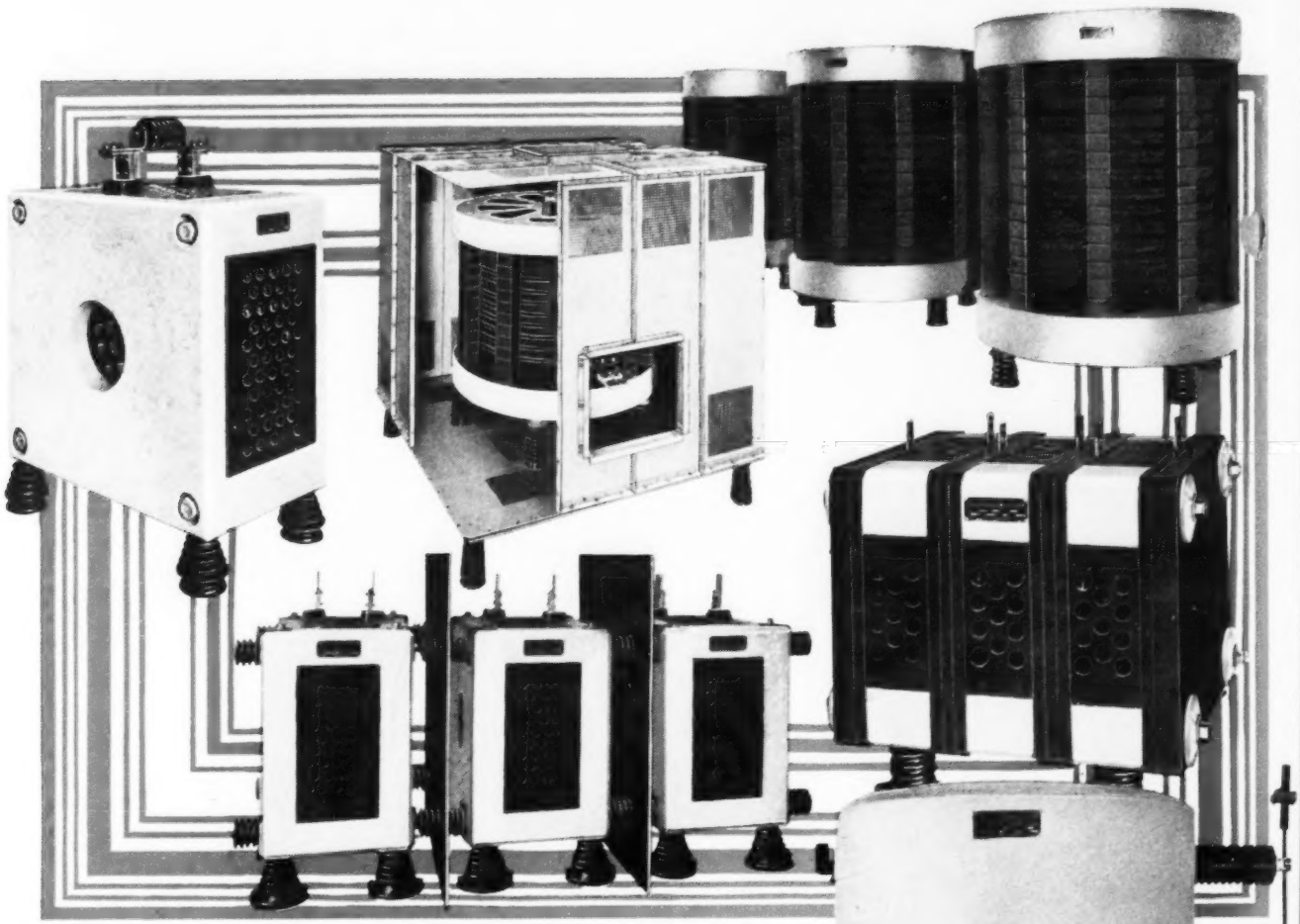
Output Trend
Seven Years Experience with "SS" Cable
Scheduled Network Inspection
Water Heater Sales Factors
Electronic Process Controls
Customer Service Quality Control

Right-angle corner with self-supporting cable



GUARDING THE ARTERIES OF Electrical America!



Electric power lines are the veins and arteries of America's *industrial* life. Electric current is the life-blood. Stop it—and you stop the nation. Standing guard over this life-line—giving it strength to withstand the first surging moments of destructive short circuits—are the hundreds of Murray Current Limiting Reactors whose obscure but vitally important function it is to keep America going. Yes—keep America going. Keep it going with Murray Reactors. Metropolitan Device Corporation, Brooklyn 16, New York.

THE PICTURES

•

TOP LEFT
900 amp. feeder reactor.
TOP CENTER
Aluminum shielded 27 K.V. 1800 amp. reactor.
TOP RIGHT
Open type 3000 amp. 13.8 K.V. reactor.
CENTER LEFT
Close spaced 600 amp. indoor reactor.
CENTER RIGHT
3 phase unit type reactor up to 4000 V.
BOTTOM
Cast in concrete outdoor type reactor.

•

Murray

CURRENT LIMITING REACTORS

Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 71 YEARS

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VITAL VEINS torn out too soon?

the prevention: *Adequate Wiring*

Only adequate wiring written into the plans can protect new buildings against far-too-early electrical obsolescence . . . can provide plenty of power for plenty of years.

Big as today's loads are, tomorrow's will dwarf them. Lighting intensities are still going up. Further increases in demand will be made by air conditioning, fluorescent lighting, electrical office and production machines and electronic equipment — to mention a few of many current-consuming future necessities.

HOW TO BE PREPARED ELECTRICALLY

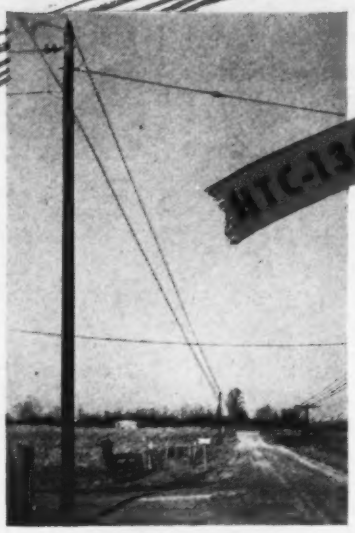
When planning electrical systems for industrial buildings, commercial buildings and institutions, you can act on this principle: "More Power Sources and More Power at Each Source." For example, you can take one or more of these steps: You can make sure of ample copper in the wires and cables; you can provide more electrical outlets; for industrial buildings you can provide operating economies through high voltage cables and unit sub-stations at load centers. You can provide savings through power factor correction with such equipment as synchronous motors and capacitors. For the right wiring for each particular job, you can go over your plans with a consulting electrical engineer or an experienced electrical contractor or an engineer of The Okonite Company, Passaic, N. J. or The Hazard Insulated Wire Works Division, Wilkes-Barre, Pa.

OKONITE insulated wires and cables

Line wire

As distributor of *Crapo* galvanized wire and strand, GRAYBAR offers you steel conductors which provide an unusual combination of advantages: high tensile strength, high fatigue endurance, and relatively low electrical resistance. These conductors are especially applicable to rural branch distribution lines. They make possible long spans with flat sags, reduce the number of pole structures required, cut over-all construction costs. They withstand heavy ice and wind loads, help minimize service interruptions and keep down maintenance expense.

Get prices and complete technical data from the GRAYBAR Outside Construction Specialist near you. Call him, too, for first-quality pole-line hardware, poles, crossarms, insulators, pins, accessories, and tools — all the supplies you need for line construction and maintenance. *Graybar Electric Company, Graybar Building, New York 17, N. Y.* 4532

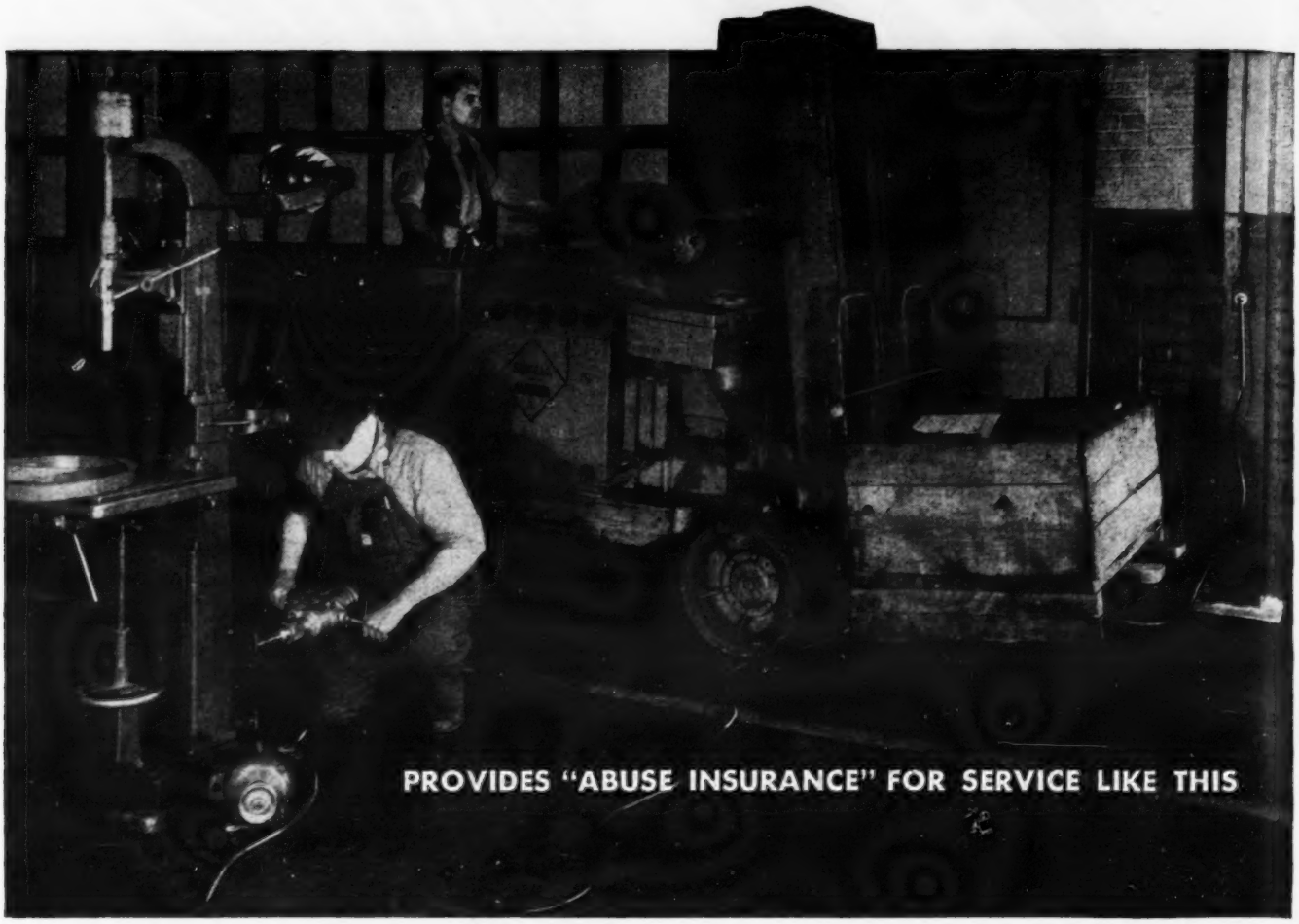


Crapo HTC-130 Steel Conductors possess exceptionally high tensile strength, permit extra long spans. Furnished in sizes 4, 6 and 8 B.W.G. — solid or stranded (3-wire) — without splices or welds.

Crapo HTC-80 Steel Conductors are designed for shorter spans than *Crapo* HTC-130. Made in sizes 4, 6 and 8 B.W.G. — solid or stranded (3-wire) — without welds or joints.

IN OVER 80 PRINCIPAL CITIES

Wire insulation of Geon is tough!



FORMAL tests by a leading testing laboratory show that insulation made of GEON for SN wire can stand twice the pressures that ordinary insulation can take in the Olsen compression machine. Informal tests of this insulating material for portable cable indicate an even better crush test record.

Translated into performance these test results mean that insulation of GEON will stand abuse and rough treatment that would quickly ruin ordinary insulating materials. The picture shows one such service—portable cable for a maintenance tool used in a large factory where the insulation takes a terrific beating.

Many other of GEON'S important properties are useful in this service, too. Excellent electrical properties, of course. And resistance to oil, abrasion, chemicals, air, heat, flame, water and many other normally destructive factors. In other types of service, the use of GEON will permit thinner coatings of insulation —more conductors per conduit. Its slick surface means easy installation. GEON can be brilliantly colored in the entire NEMA range for quick, positive identification.

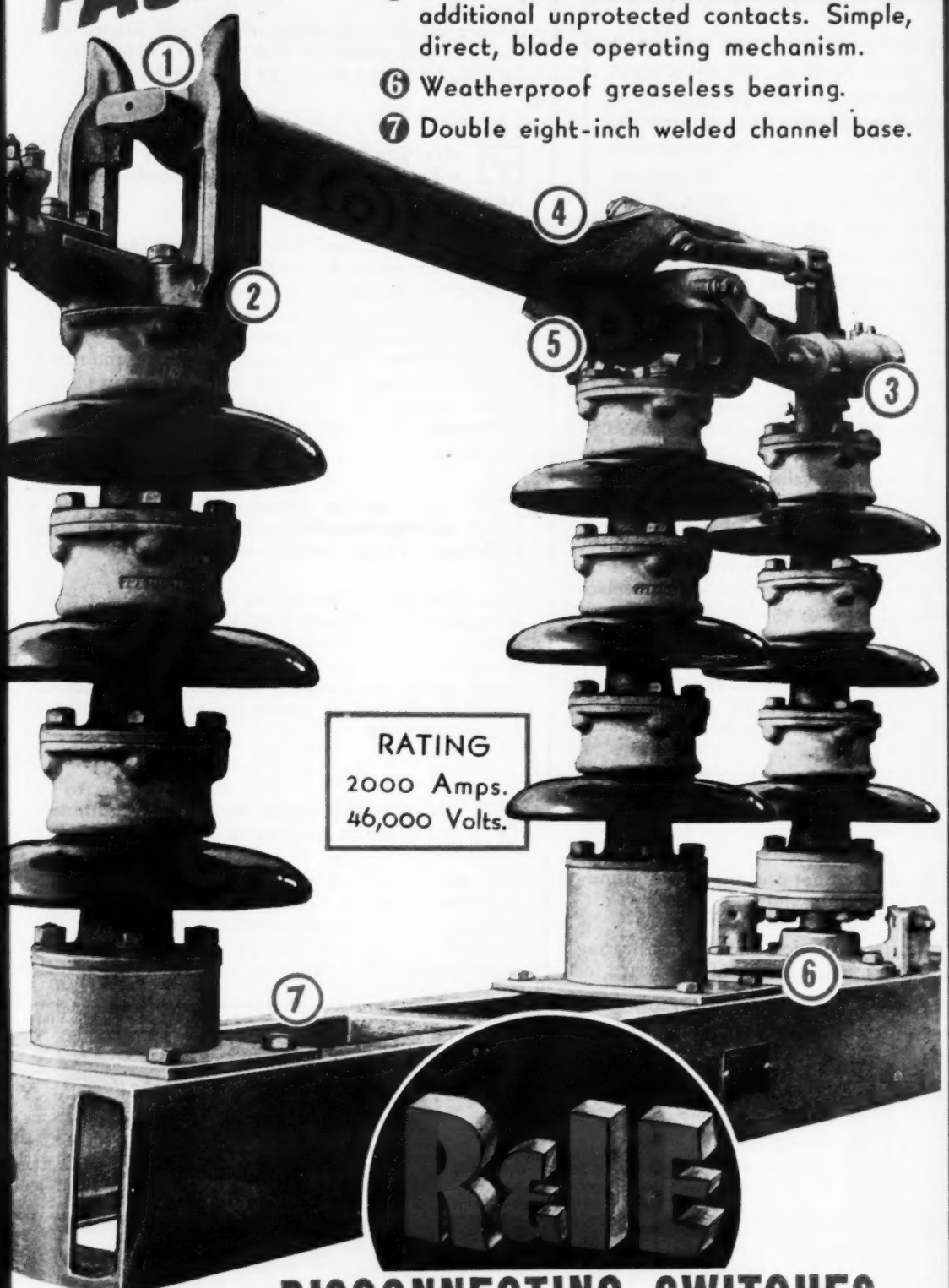
Urgently needed for military uses, all the GEONS are subject to allocation by the War Production Board. Limited quantities are available for experiment, and our development staff and laboratory facilities will help you work out special problems or applications. For more complete information write Department CC-4, Chemical Division, The B. F. Goodrich Company, 324 Rose Building, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

CHEMICAL DIVISION
The B. F. Goodrich Company
ROSE BUILDING • CLEVELAND 15, OHIO

CHECK the FACTS

1. Hi-Pressure Contacts, self cleaning with each blade operation.
2. One piece jaw and terminal pad.
3. Blade counterbalanced in any position. Requires only normal operating effort.
4. All copper current carrying parts.
5. Heavy braid flex at hinge joint—eliminates additional unprotected contacts. Simple, direct, blade operating mechanism.
6. Weatherproof greaseless bearing.
7. Double eight-inch welded channel base.



DISCONNECTING SWITCHES

RAILWAY AND INDUSTRIAL ENGINEERING CO. GREENSBURG, PA.

The Check List

CONDUCTOR SUPPORTS CLAMPS AND FITTINGS

DISCONNECTING SWITCHES INDOOR AND OUTDOOR

HORN GAP SWITCHES

INTERRUPTER SWITCHES

CUTOUTS AND THERMO-RUPTERS

SWITCH OPERATING MECHANISMS

SUBSTATIONS

OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES

KIRK INTERLOCK SYSTEMS

AUTOMATIC EQUIPMENT

METAL CUBICLES

TESTING DEVICES

Check List

Today many utilities are taking a fresh look at the oil circuit breakers which protect their equipment and service continuity. Rapid system growth, wartime buying restrictions, important developments in circuit breaker design — these are some timely reasons why. Thus Allis-Chalmers now offers the following check list to utilities *as a partial guide to circuit breaker replacement when buying again becomes possible.*

☑ **Do you want to get increased breaker capacity without installing new breakers?**

PERHAPS your present breaker interrupting capacity is inadequate to handle the higher short circuits and voltage surges imposed by system growth... yet, major changes in station layout to accommodate additional breakers might not be practicable just now. If this is your problem, Allis-Chalmers' answer is to modernize — to replace plain-break contacts of existing oil circuit breakers with modern Ruptors (or to replace present Ruptors with larger ones).

The Ruptor is an Allis-Chalmers arc-enclosing device which limits arc energy, keeps tank pressures low, quenches arcs lightning-fast . . . *both reduces maintenance costs and gives added capacity.*

NOTE: All Allis-Chalmers oil circuit breakers above 50,000 kva rating are Ruptor-equipped.

☑ **Do your breakers meet present NEMA standards for interrupting time?**

ALLIS-CHALMERS makes a complete line of quick-clearing 8-cycle circuit breakers, meeting the NEMA Standard for outdoor oil circuit breakers, 69 kv and below. Allis-Chalmers also meets the new 5-cycle NEMA Standard for circuit breakers of 115 kv rating and above.

☑ **Are you getting a satisfactory number of oil circuit breaker operations between maintenance periods?**

SLUDGING OF OIL and burning of contacts can create such a maintenance burden that old-type circuit breakers become uneconomical to operate.

Allis-Chalmers' field and laboratory tests prove that Ruptors will enable breakers to handle *many more circuit interruptions* before requiring inspection and renewal of oil or contacts. This is a result of limited release of arc energy, since the Ruptor device greatly lessens the amount of oil exposed to the arc.

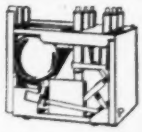
☑ **Have service interruptions been traced to mechanical difficulties in present circuit breakers? Faulty adjustment?**

ALLIS-CHALMERS' "permanent adjustment" — assured by rigidity in stationary parts and the generous cross-sections of moving parts — is your guarantee of dependable breaker performance, with adjustment maintained under all operating conditions. Stop nuts and other reliable locking means are used throughout the breaker structure.

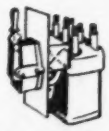
☑ **Does arcing cause excessive maintenance on contacts of present breakers?**

ALL MOVING and stationary contacts on Allis-Chalmers' complete line of oil circuit breakers are of special arc-resisting alloys, and main contacts are liberally silver-surfaced, giving much longer service-life than older type contacts. And remember that most Allis-Chalmers

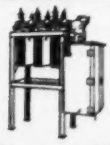
E-145 — 200-400 amp, 2500 volts, 15,000 kva int. cap.



AB Line — Indoor air blast; 15 kv, up to 500,000 kva.



D-20 — 600-1200-2000 amp, 5 kv, 50,000 kva.



O Line — 7.5 to 46 kv, 50,000 to 250,000 kva.

FZO-150 — 15 to 69 kv, 500,000 to 1,500,000 kva.

ALLIS-CHALMERS *makes a*

HOW ADEQUATE IS YOUR SYSTEM PROTECTION TODAY? HERE ARE MAIN OIL CIRCUIT BREAKER FACTORS TO BE CONSIDERED NOW

oil breakers are Ruptor-equipped — slashing time the arc exists between circuit breaker contacts.

☑ **Have you considered the advantages of complete circuit breaker weatherproofing?**

RECOGNIZING the importance of weatherproofing for breaker safety, Allis-Chalmers has designed the *FZO-150* outdoor oil circuit breaker.

The new breaker has compact, smooth, all-welded steel top . . . giving maximum protection against wind-driven sand, snow, sleet and water . . . no crevices to collect water and dirt. All external conduits have been eliminated. Bushing transformer wiring is run in isolated ducts incorporated in the top frame.

☑ **Do your circuit breakers meet present NEMA and AIEE Insulation Standards?**

THE DIELECTRIC strength of Allis-Chalmers circuit breakers is always equal to or exceeding the latest NEMA and AIEE Standards. All bushings have the capacity to withstand mechanical impacts, as well as stresses due to high inrush currents.

☑ **Have you considered ultra-rapid breaker reclosing for service continuity on high voltage overhead lines?**

MOMENTARY SURGES on transmission lines — due to lightning or switching — need not mean breaks in system continuity. With ultra-rapid reclosing of breakers, such faults can be cleared from the line within 20 cycles, without disturbing the timing of synchronous machinery.

Ultra-rapid pneumatic operators — available in Allis-Chalmers outdoor oil circuit breakers rated 15 kv and higher, 500,000 kva and above — are simple in operation, compact, economical. Allis-Chalmers also offers high speed reclosing with a-c and d-c solenoid operators.

☑ **Is a d-c supply readily available for solenoid operation of high speed breakers?**

IF NOT, and if you want to avoid the use of rectifiers, for conversion from an a-c power source, Allis-Chalmers recommends a pneumatic operator.

Using the automatically maintained, pre-stored energy of compressed air to close the breaker, pneumatic operators give the quick reversal of moving parts required during reclosure . . . provide maximum closing speed throughout the stroke.

☑ **Could you profit by engineering assistance in applying new oil circuit breakers to changed system conditions?**

IN ADDITION to the actual equipment you buy, Allis-Chalmers offers engineering cooperation, backed by 40 years of experience in the design and manufacture of protective equipment for the electrical industry.

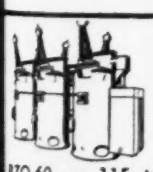
For more detailed information on the complete A-C line of oil circuit breakers, call our nearby district office. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

CHECK THESE NEW

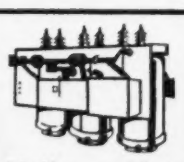
Allis-Chalmers Breaker Features:

- ☑ **Ruptors for 5-cycle opening of larger outdoor breakers.**
- ☑ **Modern high-speed solenoid operators.**
- ☑ **Pneumatic operators, for ultra-rapid (20-cycle) reclosing.**
- ☑ **All-welded "Unitop" frame on streamlined breakers.**

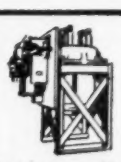
A 1835



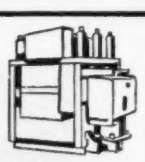
BZO-60 — 115 to 230 kv, 1,000,000 to 2,500,000 kva.



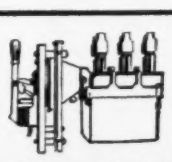
FZ Line — 15 to 34.5 kv, up to 2,500,000 kva.



DZ Line — Up to 2000 amp, 15 kv; 100,000-500,000 kva.



AM Line — Magnetic air; 5 kv, up to 150,000 kva.

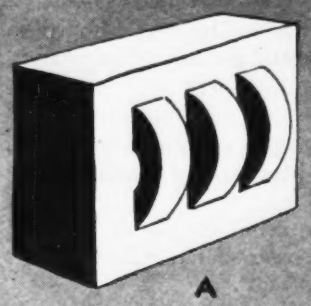


E-47 — 400-600-800 amp, 5 kv, 25,000 kva int. cap.

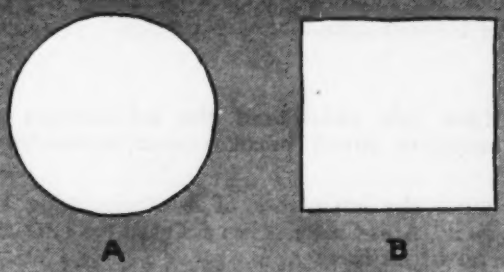
Full Line of Circuit Breakers

How Would You Design

AT LEAST 6 DECISIONS



1 Would you use (A) shell type, or (B) core type construction?



2 Would you use (A) circular coil construction, or (B) rectangular coils?

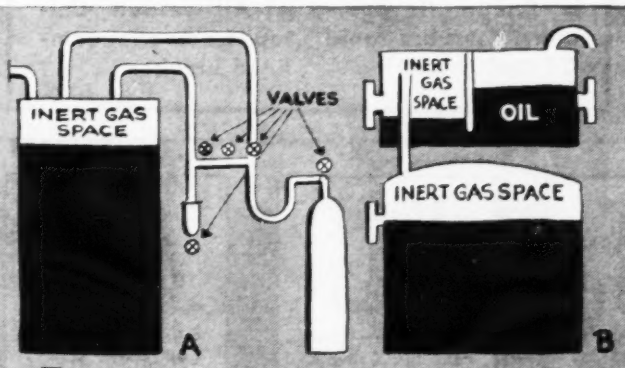
1 FOR SMALL, moderate voltage and moderate size transformers, core type construction is simple and economical. For large, high voltage transformers, however, the shell type construction has definite superior voltage characteristics and inherent electrical and mechanical strength. Allis-Chalmers makes *both* types of transformer. The decision on which to build for your needs is based on the application of sound engineering principles.

2 A CONDUCTOR carrying an electric current around a magnetic field tends to assume the form of a circle. Therefore, you would probably design your coil circular to avoid deformation stresses in operation.

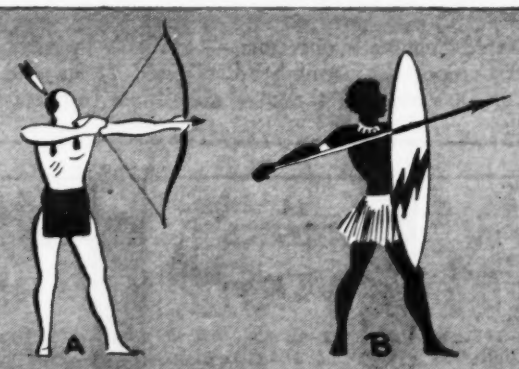
Allis-Chalmers uses circular coils on all power transformers for this reason, and also because circular coils can be wound with uniform tension. Conductors need not be pounded into shape around sharp corners.

3 YOU WOULD probably put the no-load tap changer handle in the most convenient and least hazardous zone — at the side of the transformer. This is where Allis-Chalmers places all no-load tap changer operating handles.

Tap positions can be read from the ground . . . without coming near to high voltage bushings. Location at the side of the transformer also makes it more convenient to operate the tap changer handle.



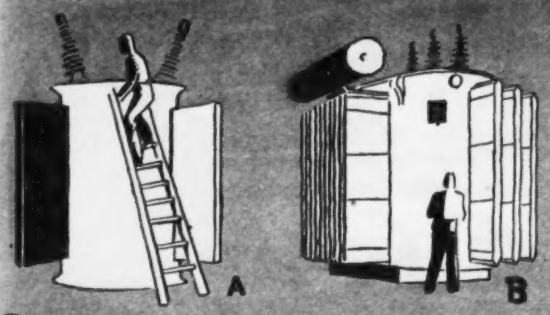
5 Would you regulate inert gas with (A) high pressure valve system, or (B) with an oil-sealed system?



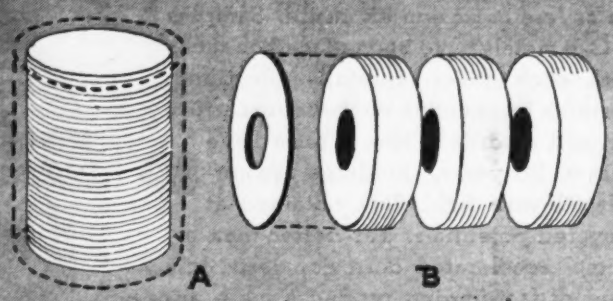
6 If you employed load-ratio control, for tap changing under load, would you use the quick-break principle (A) or the slow-break principle (B)?

a Power Transformer?

MAY BE INVOLVED . . .



3 Would you place the no-load tap changer handle (A) on the cover of the transformer, or (B) at the side of the transformer?



4 Would you (A) shield the entire winding, or (B) obtain uniform voltage distribution through overall transformer design and use a shield over just the first coil?

4 THE AMOUNT of shielding needed would depend on the characteristics of the transformer. However, the greater the portion of winding shielded, the greater is the dynamic stress between shield and winding.

The Allis-Chalmers shell type design inherently has uniform voltage distribution characteristics, and therefore it is possible to use a shield over the first coil only. Greater reliability and simplicity of construction result.

5 REDUCING pressure from 2000 pounds in an inert gas tank to the 5-10 pounds required over the oil in the transformer involves the use of complicated valve mechanisms.

The oil-sealed system, on the other hand, has no moving parts, high pressure tanks, or valves — yet it provides full inert gas protection.

Thus an oil-sealed inert gas system, as offered by Allis-Chalmers, would be the logical choice.

6 IF YOU added the advantages of load-ratio-control to your transformer, you would probably employ quick-break design — which contrasts in principle with slow-break as shooting an arrow contrasts with throwing a spear. High speed contact separation shortens arcing time, reduces burning, lengthens contact life.

Get the full story on power transformers from our nearby district office. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 1777

Invest in

ALLIS-CHALMERS

Power Transformers

Can you Specify ALL you want

Located at the junction of two main-line railroads and surrounded by belching factory chimneys, the roof of the O-B laboratory provides a natural location for severe corrosion exposure. Samples of O-B metals have been placed on racks with each piece carefully identified. Periodic inspections and tests are carried out and recorded. Many items have passed 20 years. Findings are correlated with field data obtained at elevated potentials. Far better than artificial accelerated corrosion tests, this kind of fact-finding produces more authentic answers; better guides O-B design engineers.

Does this kind of product control furnish any answer as to how *you* may get *all* you want in hardware performance?

Built in 1917, this 132-kv., 17-mile line utilized 20,277 O-B suspension units. In the 28 years of its operation, outages have been extremely rare. No insulators have been removed from service due to any inherent defect.

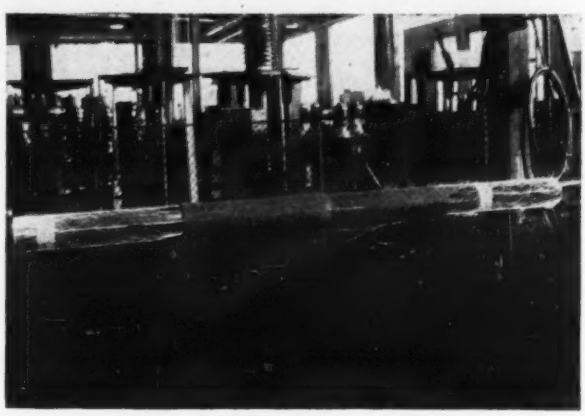
Does this kind of record furnish any answer as to how *you* may get *all* you want in reliable suspension insulator performance?

in an INSULATOR?

Rigid specifications and standards surround the manufacture of insulators, but can you specify *all* you want? You can call for M. & E. tests, wet and dry flashover results, and adherance to accurate dimensions, but these don't assure you of getting those qualities that make for long life and freedom from trouble. These things are the intangibles that depend upon men; not upon machines or materials. These are the intangibles that add up to the most tangible thing in an insulator--performance. How do you get it? Here are a few ways this is done.

Wartime power demands often result in operation of sub-station equipment at loads exceeding contemplated requirements. Many a power executive has wondered how well his bushings can take it. It is hard to anticipate or specify the reserve you want in a bushing, but the rugged porcelain inside O-B bushings has such reserve in abundance. Porcelain insulation has the unique property of sustaining a three-minute 60-cycle dry flashover of the insulating elements as a routine factory proof test.

Does this kind of construction furnish any answer as to how *you* may get *all* you want in bushing performance?



Switch and bus insulators are a highly standardized product--that is, highly standardized *when new*--but they don't stay new! O-B has operating records covering more than 30 years. A sizeable number of these old insulators remain in service today. Many thousands more have been added. All are being watched by their owners because of their critical service. Above all claims we might make rises this one fact: most orders come to us from present users, based upon their own operating records. When a man keeps coming back for more, he knows what he is getting.

Does this kind of buying furnish any answer as to how *you* may get *all* you want in station insulation?

Ohio Brass

MANSFIELD, OHIO, U.S.A.

CANADIAN OHIO BRASS CO. LTD., NIAGARA FALLS, ONTARIO

KEEP BUYING WAR BONDS

THIS YEAR, really

GET THE DROP ON LIGHTNING OUTAGES

Specify S&C

UNIVERSAL FUSE LINKS

Performance records of large operating companies provide proof that S&C Fuse Links save outages, service trips, money and manpower.

Backed by more than a quarter-century of S&C development to leadership in the power fuse field.

S&C LINKS ARE:

- Stronger mechanically—no soldered joints.
- Highly resistant to corrosion and oxidation.... silver current-responsive elements.
- Precision-engineered, precision-produced.

. . . AND GIVE YOU:

- Capacity to withstand lightning-induced surges and transients.
- Freedom from unnecessary service interruptions.
- Accurate time-current characteristics.
- Longer trouble-free life at lower cost per link.
- Universal applicability to all makes of cutouts.

It will pay you to have all the facts about this S&C protection. Write for Bulletin 218-A.

SCHWEITZER & CONRAD, INC.

4421 Ravenswood Ave., Chicago 40, U. S. A.

Represented in Principal Cities (Consult Telephone Directory)
In Canada by Powerlite Devices, Ltd., Toronto, Ont.

"Experience Will Choose An S&C Fuse"

EXIDES, always ready for any battery assignment . . .

Exides have the high voltage and capacity needed to meet all the storage battery requirements of light and power stations. In many hundreds of stations they perform a multitude of duties—closing and tripping switch-gear, operating the control bus, supplying current for motor generators, motor converters, rotary converters or rectifiers, indicating lamps, etc. And in numerous installations they stand ready to take over, automatically, the supply of emergency lighting.

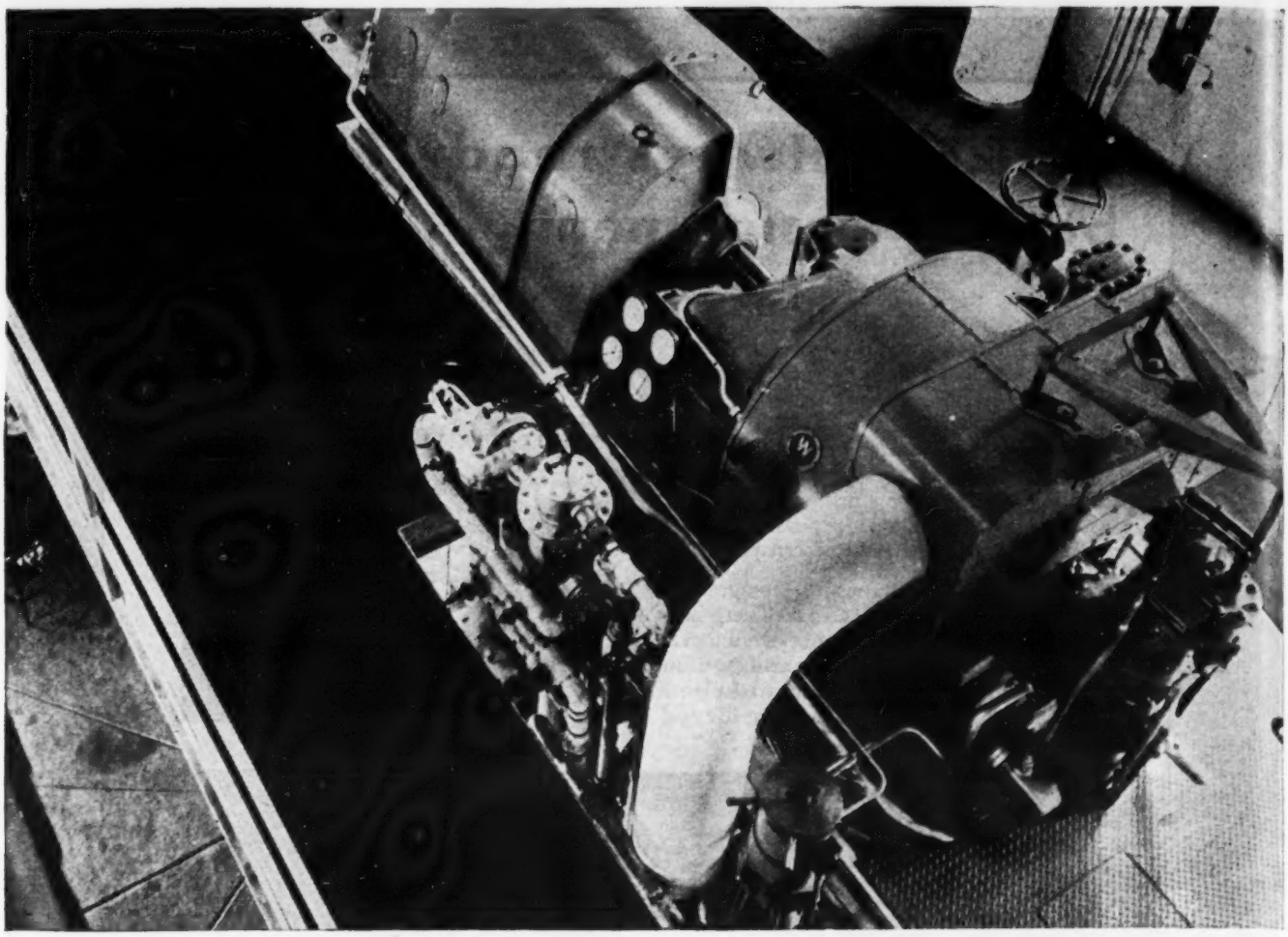
Exide makes several types of storage batteries for control bus operation. These batteries have earned the confidence of engineers everywhere, and their widespread use in public utilities and private industrial plants is proof of their dependability, long-life and ease of maintenance. When you buy an Exide, you *Buy* to *Last*.

Whatever your battery problems, Exide engineers will be glad to help you solve them.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

ARMY E NAVY

Exide
BATTERIES



Mainspring of Industry

ELECTRICITY is the mainspring of industry—the driving force for 90% of America's productive machinery. To meet unprecendented demands, output of public utility generating plants alone has been boosted to more than 231,000,000,000 kilowatt-hours annually.

In both steam and hydro turbines, effective lubrication is essential to dependable, trouble-free operation. In the experience of plant operators everywhere, this is best assured with lubricants specially designed for turbine use . . . *Texaco* lubricants, available for every type of turbine.

Texaco Regal Oils (R & O) for example, are scientifically designed to prevent rusting of turbine lubricating systems. They are highly resistant to oxidation, foaming, sludging and gum formation. Because of these qualities, *Texaco Regal Oils (R & O)* keep turbine systems clean, bearing temperatures normal, governor action smooth and sensitive. They fully meet specifications of all leading turbine builders and the turbine oil specifications of the U. S. Navy.

Texaco lubricants have proved so effective in service they are definitely preferred in many fields, a few of which are listed at the right.

For suggestions on the proper care of oil and maintenance of turbine systems call on Texaco Lubrication Engineering Service, available through more than 2300 Texaco distributing plants in the 48 States. The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ *More revenue airline miles in the U. S. are flown with Texaco than with any other brand.*

★ *More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.*

★ *More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.*

★ *More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.*

★ *More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.*

TEXACO

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON EVERY SUNDAY NIGHT — CBS

This rugged, non-deteriorating path for Lightning combined with their highly efficient operating characteristics has given Crystal Valves an enviable reputation under all operating conditions.

LINE LEAD—No. 6 B. & S. gauge stranded cable.

ARCING UNIT—Multiple gap type having high speed, heavy gauge electrodes assembled on steatite ceramic rod with steatite spacers. High quality, long lasting construction.

CHARACTERISTIC ELEMENT—Oxidized Silicon Carbide crystals which show no measurable deterioration after years of normal service.

GROUND END CONSTRUCTION—is made up of solid brass parts, providing clamp for attaching one or two No. 6 B. & S. gauge conductors.

Sectional View of Typical Crystal Valve Lightning Arrester

ELECTRIC SERVICE MANUFACTURING CO. • 17th & CAMBRIA STS., PHILADELPHIA 32, PA.

CRYSTAL VALVE
LIGHTNING ARRESTERS

FOR SMALL STATION OR LARGE...

Alcoa Aluminum BUS BARS

Advantages offered by Alcoa Aluminum bus bars apply to all types and sizes of stations. In the two pictured here, for example—the stiffness and light weight of Alcoa tubular bus permits wide spacing of supports. This results in simpler construction, with economies in labor and materials.

Alcoa Aluminum bus bars and fittings are available for WPB-approved projects. As always, Alcoa engineers will be glad to assist you in selecting the proper size and type of conductors and fittings. Write ALUMINUM COMPANY OF AMERICA, 2138 Gulf Building, Pittsburgh 19, Pennsylvania.

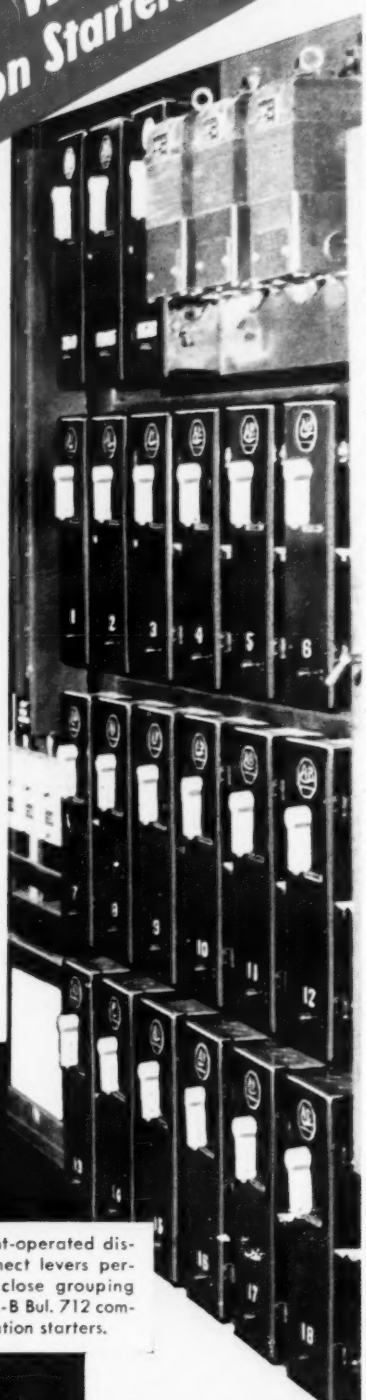
ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM

SAVE SPACE · SAVE LABOR · SAVE WIRING with Allen-Bradley Combination Starters

These Cincinnati Grinders are equipped with Allen-Bradley combination starters. A start-stop push button station is mounted near the operator, making an economical installation. Also, plant relocations can be made quickly when machines are equipped with A-B combination starters.

COMBINATION STARTERS are taking the place of the old, two-unit installations with separate disconnect switches. The saving in space, wiring materials, and labor . . . and the use of silver alloy contacts in both units . . . explain why A-B combination starters are so popular. For the complete story, send for Bulletin 712.



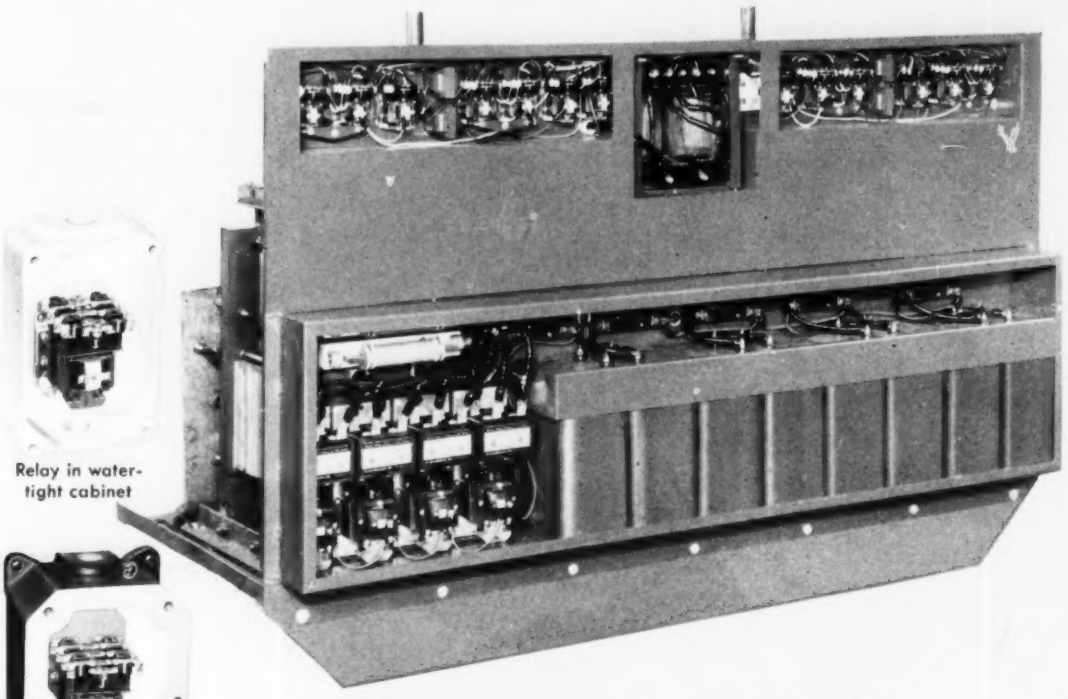
Front-operated disconnect levers permit close grouping of A-B Bul. 712 combination starters.

A-B Quality

ALLEN-BRADLEY

BULLETIN 712 SOLENOID COMBINATION STARTERS

QUALITY



Relay in water-tight cabinet

Relay in general purpose enclosure

Relay in enclosure for explosive atmospheres

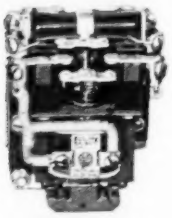
12-Pole relay in general purpose enclosure

SEVENTEEN A-B RELAYS AND CONTACTORS
on Transformer Type A. C. Welder

Courtesy Glen Richards Company, Oakland, Cal.

RELAYS

800 STANDARD TYPES...TO FIT YOUR SPECIAL NEEDS

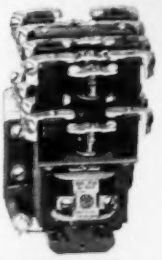


Thermostat Relay 2 N. O. Contacts

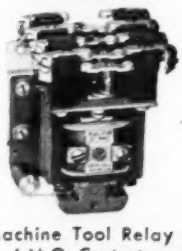
Allen-Bradley relays are designed to electric motor control standards with adequate electrical clearances. They are ruggedly constructed ... and good for millions of trouble-free operations. Only a few of the hundreds of standard Allen-Bradley units are shown on this page. The combinations of contacts, circuits, and enclosures are so extensive that you can easily find a standard relay that will exactly fit your requirements.

Bulletin 700-200 on AC-DC relays is a valuable encyclopedia on relay applications. We will gladly mail a copy on request.

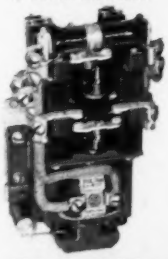
Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.



Machine Tool Relay 8 N. O. Contacts



Machine Tool Relay 4 N. O. Contacts

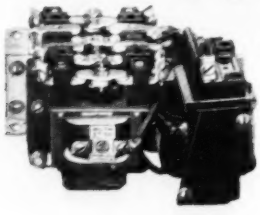


Thermostat Relay 4 N. O. Contacts

ALLEN-BRADLEY

A-C D-C RELAYS AND CONTACTORS

QUALITY



Transformer-Type Relay 2 N. O. and 2 N. C. Contacts

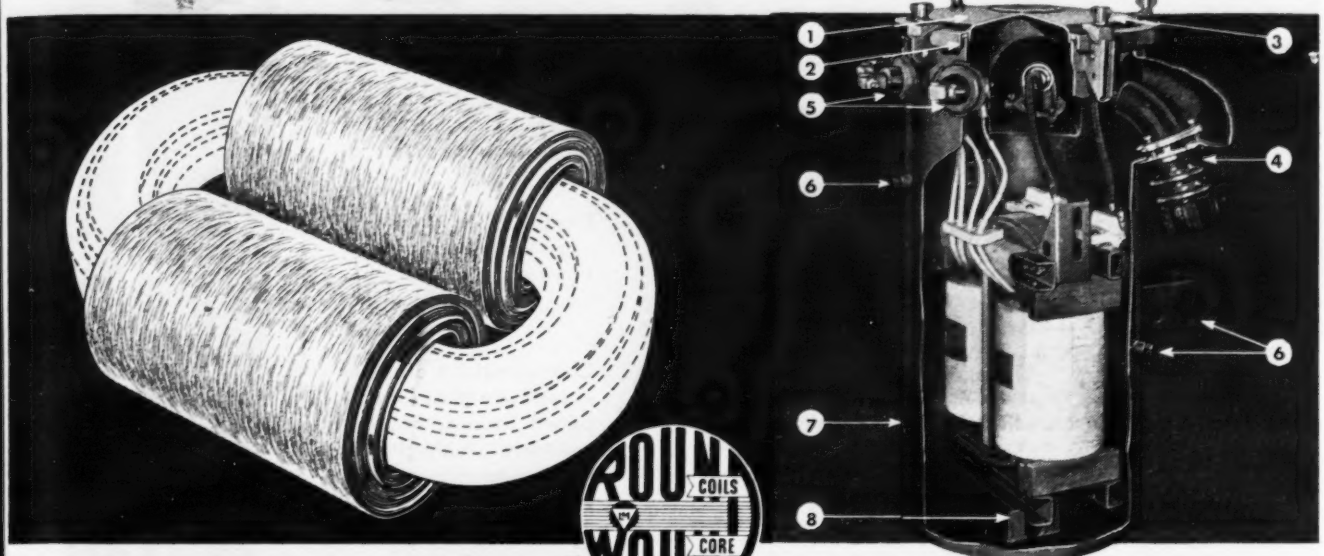
Machine Tool Relay 2 N. O. and 2 N. C. Contacts

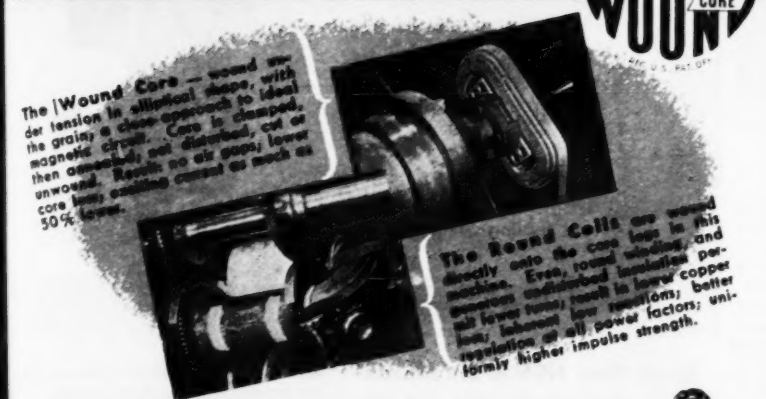
Here's what you get ...and why...in LM Round Wound TRANSFORMERS

L-M Round-Wounds *Increase your Revenue.* Because they give improved regulation at all power factors, L-M Round-Wound transformers deliver increased voltage to your customer. Thus they increase your operating revenue, and also your *rate* of profit per kilowatt-hour.

L-M Round-Wounds *Cut Operating Costs.* Because they have a better loss ratio—lower copper loss and lower total loss—L-M Round-Wound transformers operate more economically. The more efficient core means less exciting current, considerable saving. Improved time-temperature characteristics and higher overload capacity give longer transformer life, less replacement cost. Higher impulse strength decreases the chances of failure caused by lightning, another reason for lower operating cost.

L-M Round-Wounds *Improve Customer Relations.* Better regulation means fewer low-voltage complaints from customers. Lower reactance cuts flicker, reduces complaints. Fewer failures caused by lightning and overloads mean fewer service interruptions. These help improve your relations with your customers.




The Wound Core — wound under tension in elliptical shape, with the grain a close approach to ideal magnetic circuit. Core is clamped, then assembly put together. Core is not disturbed, cut or unwound. Results: no air gaps; lower core loss; exciting current as much as 50% lower.
The Round Coils are wound directly onto the core legs in this machine. Even, round winding, and precision distributed insulation between turns; result in lower copper loss; inherent low reactance; better regulation at all power factors; uniformly higher impulse strength.

Ask the L-M Field Engineer for details, counsel, on use of L-M Round-Wound transformers. Call or write nearest L-M branch, or Line Material Co., Milwaukee 1, Wis. If interested, ask for Bulletin RW-421 . . . on Round-Wound Construction.

LEAK-PROOF TANK AND BUSHINGS

1. Cover—strong, rigid, will not distort. Skirted edge keeps rain off gasket.

2. Gasket held in double channel in cover; tank edge rolled, will not cut gasket.

3. Four cover clamps; assure tight seating of cover, easy removal when necessary.

4. High voltage bushings double sealed; protected by pocket on tank. Available in cover mounted types.

5. Low voltage bushings stud-type; oil-tight; held by external clamp, easily removed.

6. EEI-NEMA standard mounting brackets and ground pads.

7. Copper-bearing rust-resisting steel tank triple-coated. Upside-down test of filled transformer assures freedom from oil leakage.

8. R-W core-coil assembly rigidly mounted top and bottom. Twelve tough tests assure performance of complete unit.

Simple, rugged tap-changer available; handle and indicator above oil level. No loose parts to fall off.

Available in 1½ to 25 Kva, 2500 to 7620 volts. Meet latest EEI and NEMA standards.

LM

LINE MATERIAL
TRANSFORMERS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers • Fuse Cutouts and Fuse Links • Lightning Arresters
Oil Switches • Pole Line Hardware • Line Construction Specialties • Underground Equipment • Fibre Conduit • Street Lighting Equipment

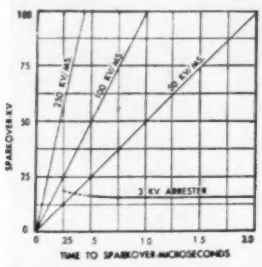
WHY years of service fail to change its unfailing, unchanging protection

LM Heavy

INSIDE INFORMATION ABOUT ITS OPERATING CHARACTERISTICS

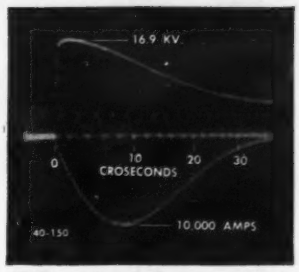
The L-M Heavy Duty Lightning Arrester assures the highest degree of protection, and the longest, most dependable service, of any lightning arrester L-M has ever produced. Field failures are negligible. Its ability to give years of unchanging protection means lower arrester costs. Read, below, the description of design features that contribute to these desirable characteristics. Then get full details, in Bulletin LA 40151, from the L-M field engineer, the nearest L-M branch or Line Material Co., Milwaukee 1, Wisconsin.

Features Assuring High Level of Protection



Goes into Action Fast

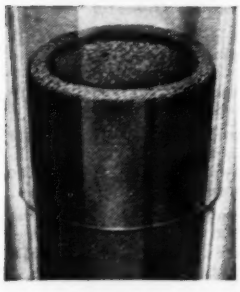
As the volt-time curve of 3 Kv arrester shows, the electrically-fast ladder gap goes into action early, before surge can build up to dangerous value. Gap is a precision device, with consequent quick response to steep wave fronts. This fast action is a major factor in the high degree of protection L-M Arresters give the transformer.



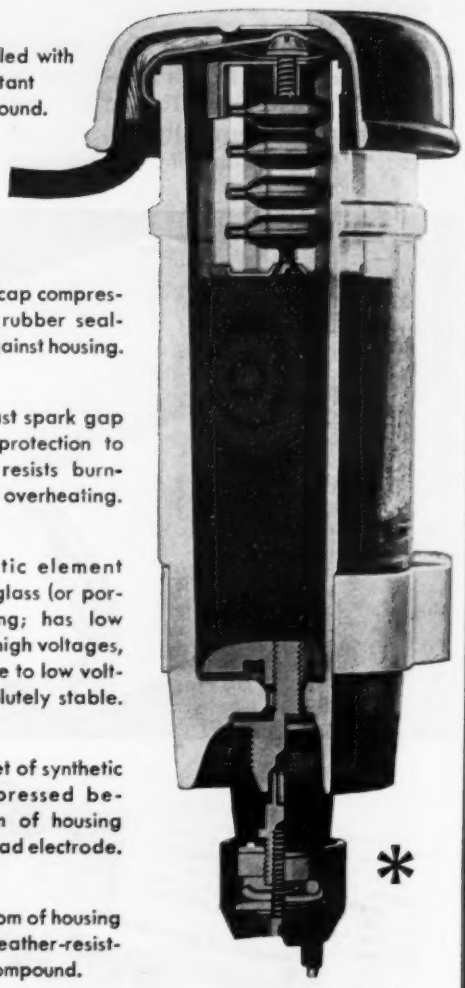
IR Drop Low, Capacity High

Oscillogram above shows IR drop only 16.9 Kv on 10,000-amp. surge; it is but slightly higher on much greater surges. This moderate IR drop protects transformer with a large safety factor on surges of many thousand amperes. Arrester handles, without damage, the 65,000-amp. surge specified in NEMA and AIEE standards, showing its high discharge capacity.

Stability Assures Permanent Protection



The characteristic element, heart of the L-M Heavy Duty Arrester, is a material selected for its low resistance at high surge voltages, and its high resistance on normal line voltage. The material is electrically and chemically stable. Surge tests show conclusively that it permanently retains its high discharge capacity and resistance to follow currents. That is why L-M Heavy Duty Lightning Arresters give so many years of unfailing, unchanging protection.



Glass cap, filled with weather-resistant sealing compound.

Spun copper cap compresses synthetic rubber sealing gasket against housing.

Electrically fast spark gap —maximum protection to transformer; resists burning, pitting, overheating.

Characteristic element molded into glass (or porcelain) housing; has low resistance to high voltages, high resistance to low voltages; is absolutely stable.

Sealing gasket of synthetic rubber compressed between bottom of housing and ground lead electrode.

Concave bottom of housing filled with weather-resistant sealing compound.

Meet New NEMA Standards

All L-M Heavy Duty Lightning Arresters meet the new NEMA standards. In repeated tests, these L-M Arresters maintain uniform performance characteristics.

Made in Six Sizes

Ratings from 1 to 15 Kv.

LINE MATERIAL
LIGHTNING ARRESTERS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers · Fuse Cutouts and Fuse Links · Lightning Arresters · Oil Switches · Pole Line Hardware · Line Construction Specialties · Underground Equipment · Fibre Conduit · Street Lighting Equipment

Duty Lightning Arrester

HEAVY DUTY DESIGN ASSURES YEARS OF UNFAILING OPERATION

Glass cap; No. 6 flexible line lead, soldered to copper cap. Also available with solderless connector mounted on wet process porcelain cap.

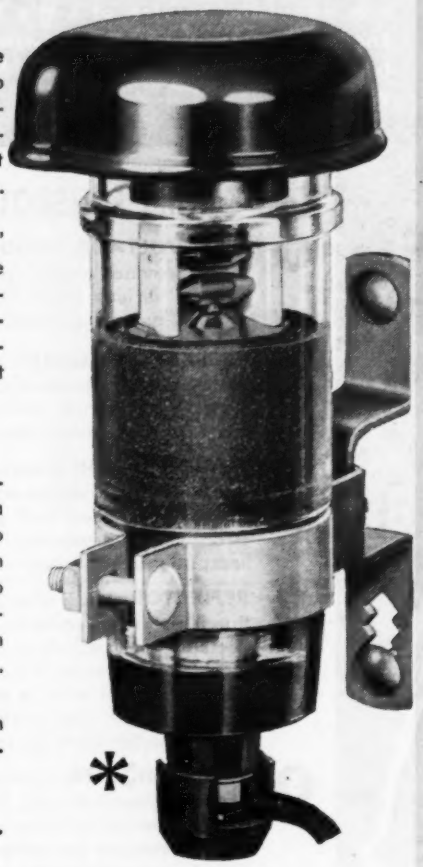
Heat-resisting "Pyrex*" glass housing. A glance shows condition of arrester. (NOTE: during war, porcelain housings are supplied on part of L-M production.)

*Reg. Trade Mark.

Characteristic valve element is in the form of a solid block *molded* into the glass housing. Molten copper is sprayed onto the top of the characteristic valve element to form integral contact surface.

Adjustable cross arm hanger, hot-dip galvanized steel.

Phenolic housing of Isolator.



*"THE ISOLATOR"—An exclusive L-M feature under Pat. No. 2,315,300.

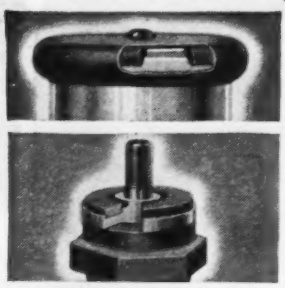
Mechanically strong solderless connector for attaching ground lead.

ASK THE L-M FIELD ENGINEER FOR BULLETIN 40151

Details of L-M Lightning Arresters; helpful information on the use of arresters. See the L-M Field Engineer when he calls; or phone or write the nearest L-M branch office or Line Material Co., Milwaukee 1, Wisconsin.

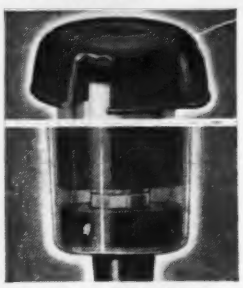
An important requirement for a lightning arrester is its ability to render years of service without change in its characteristics. This requirement received special attention in the design of L-M Heavy Duty Lightning Arresters—in the heavy construction, heavy precision ladder gap, stable valve element, double-sealing, and similar features. As a result, not only do these arresters meet NEMA standard tests, but hundreds of thousands of them are in successful service with an almost infinitesimal percentage of transformers or arresters reported damaged by lightning.

Double-Sealed Against Moisture



Inner Moisture Seals

At top, the arrester is sealed by a heavy duty, long-life, synthetic rubber gasket, compressed and held under pressure against the top of the housing by the spun copper cap. Lower seal is a similar synthetic rubber gasket, compressed in the recess in the bottom of the housing and locked by the ground lead electrode. These positive seals assure permanent protection against moisture.

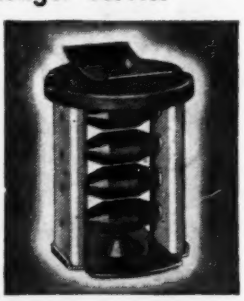


Outer Double Seals

Top of the arrester is double-sealed by filling the space between glass cap and copper cap with weather-resisting sealing compound. At bottom, recess in the housing around ground electrode is also filled with this sealing compound, which *seals the seal!* Years of service are guaranteed by L-M Double-Sealing.

Heavy Duty Means Longer Service

The precision ladder gap is typical of L-M Heavy Duty construction. Electrodes are solid alloy brass bar, machined accurately to size. These members are exactly spaced and held in position by steatite insulators. This heavy duty gap handles heavy surges without danger of serious pitting, burning, or overheating. Therefore its electrical characteristics are unaffected by discharges.



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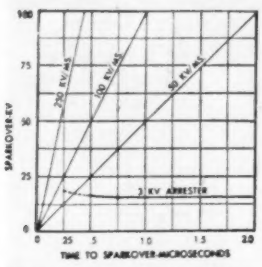

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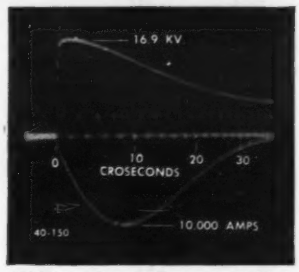
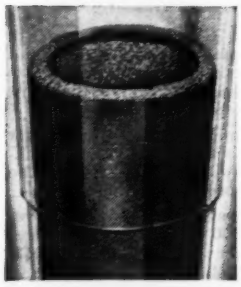


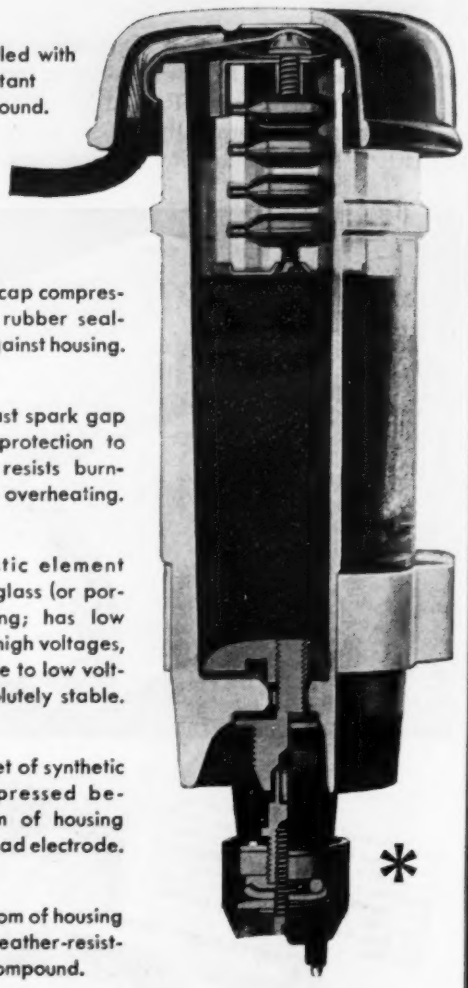
IR Drop Low, Capacity High

Oscillogram above shows IR drop only 16.9 Kv on 10,000-amp. surge; it is but slightly higher on much greater surges. This moderate IR drop protects transformer with a large safety factor on surges of many thousand amperes. Arrester handles, without damage, the 65,000-amp. surge specified in NEMA and AIEE standards, showing its high discharge capacity.

Stability Assures Permanent Protection



The characteristic element, heart of the L-M Heavy Duty Arrester, is a material selected for its low resistance at high surge voltages, and its high resistance on normal line voltage. The material is electrically and chemically stable. Surge tests show conclusively that it permanently retains its high discharge capacity and resistance to follow currents. That is why L-M Heavy Duty Lightning Arresters give so many years of unfailing, unchanging protection.



Glass cap, filled with weather-resistant sealing compound.

Spun copper cap compresses synthetic rubber sealing gasket against housing.

Electrically fast spark gap —maximum protection to transformer; resists burning, pitting, overheating.

Characteristic element molded into glass (or porcelain) housing; has low resistance to high voltages, high resistance to low voltages; is absolutely stable.

Sealing gasket of synthetic rubber compressed between bottom of housing and ground lead electrode.

Concave bottom of housing filled with weather-resistant sealing compound.

Meet New NEMA Standards

All L-M Heavy Duty Lightning Arresters meet the new NEMA standards. In repeated tests, these L-M Arresters maintain uniform performance characteristics.

Made in Six Sizes

Ratings from 1 to 15 Kv.

LINE MATERIAL
LIGHTNING ARRESTERS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers · Fuse Cutouts and Fuse Links · Lightning Arresters · Oil Switches · Pole Line Hardware · Line Construction Specialties · Underground Equipment · Fibre Conduit · Street Lighting Equipment

Duty Lightning Arrester

HEAVY DUTY DESIGN ASSURES YEARS OF UNFAILING OPERATION

Glass cap; No. 6 flexible line lead, soldered to copper cap. Also available with solderless connector mounted on wet process porcelain cap.

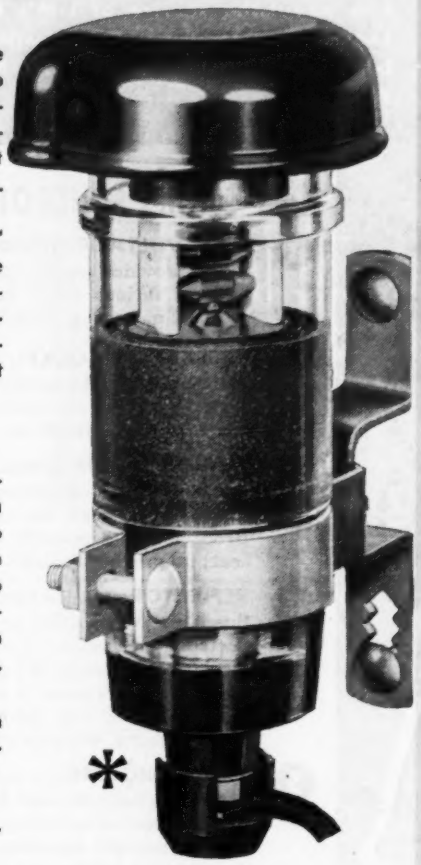
Heat-resisting "Pyrex*" glass housing. A glance shows condition of arrester. (NOTE: during war, porcelain housings are supplied on part of L-M production.)

*Reg. Trade Mark.

Characteristic valve element is in the form of a solid block *molded* into the glass housing. Molten copper is sprayed onto the top of the characteristic valve element to form integral contact surface.

Adjustable cross arm hanger, hot-dip galvanized steel.

Phenolic housing of Isolator.

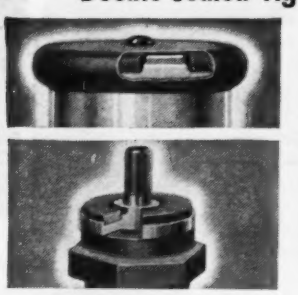


*"THE ISOLATOR"—An exclusive L-M feature under Pat. No. 2,315,300.

Mechanically strong solderless connector for attaching ground lead.

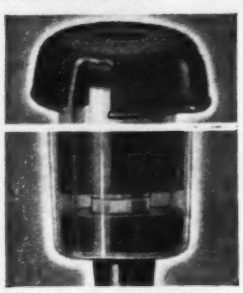
An important requirement for a lightning arrester is its ability to render years of service without change in its characteristics. This requirement received special attention in the design of L-M Heavy Duty Lightning Arresters—in the heavy construction, heavy precision ladder gap, stable valve element, double-sealing, and similar features. As a result, not only do these arresters meet NEMA standard tests, but hundreds of thousands of them are in successful service with an almost infinitesimal percentage of transformers or arresters reported damaged by lightning.

Double-Sealed Against Moisture



Inner Moisture Seals

At top, the arrester is sealed by a heavy duty, long-life, synthetic rubber gasket, compressed and held under pressure against the top of the housing by the spun copper cap. Lower seal is a similar synthetic rubber gasket, compressed in the recess in the bottom of the housing and locked by the ground lead electrode. These positive seals assure permanent protection against moisture.

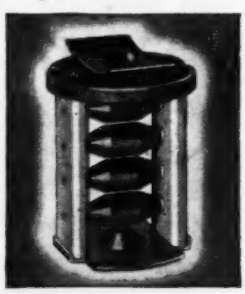


Outer Double Seals

Top of the arrester is double-sealed by filling the space between glass cap and copper cap with weather-resisting sealing compound. At bottom, recess in the housing around ground electrode is also filled with this sealing compound, which *seals the seal!* Years of service are guaranteed by L-M Double-Sealing.

Heavy Duty Means Longer Service

The precision ladder gap is typical of L-M Heavy Duty construction. Electrodes are solid alloy brass bar, machined accurately to size. These members are exactly spaced and held in position by steatite insulators. This heavy duty gap handles heavy surges without danger of serious pitting, burning, or overheating. Therefore its electrical characteristics are unaffected by discharges.



ASK THE L-M FIELD ENGINEER FOR BULLETIN 40151

Details of L-M Lightning Arresters; helpful information on the use of arresters. See the L-M Field Engineer when he calls; or phone or write the nearest L-M branch office or Line Material Co., Milwaukee 1, Wisconsin.

LM

LINE MATERIAL

LIGHTNING ARRESTERS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers · Fuse Cutouts and Fuse Links · Lightning Arresters · Oil Switches · Pole Line Hardware · Line Construction Specialties · Underground Equipment · Fibre Conduit · Street Lighting Equipment

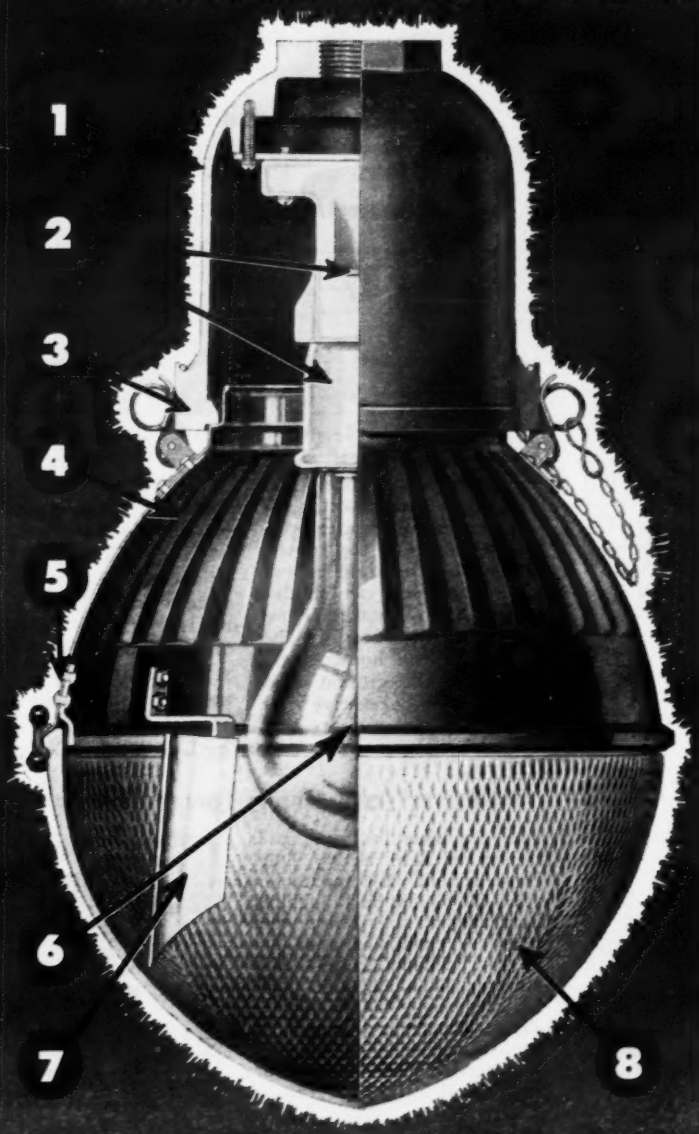
Why L-M SPHEROLITE-ing means
✓ Effective Street Lighting . . .
✓ Economical Maintenance

Increased visibility on the roadway, maximum use of the light, correct distribution, a minimum of glare: these are results of Spherolite design.

In addition, Spherolite construction provides maximum flexibility; and keeps out moisture and dirt, keeping maintenance costs at a minimum.

Get details on the many types of Spherolites, reflectors, refractors, and the complete line of L-M Street Lighting equipment to solve every street lighting problem.

Discuss your plans with the L-M Field Engineer. His knowledge and experience will help you. Ask him about the service of L-M's Illuminating Engineering Department. Call or write the nearest L-M branch, or Line Material Co., Milwaukee 1, Wisconsin.



Cost-Cutting SPHEROLITE Features

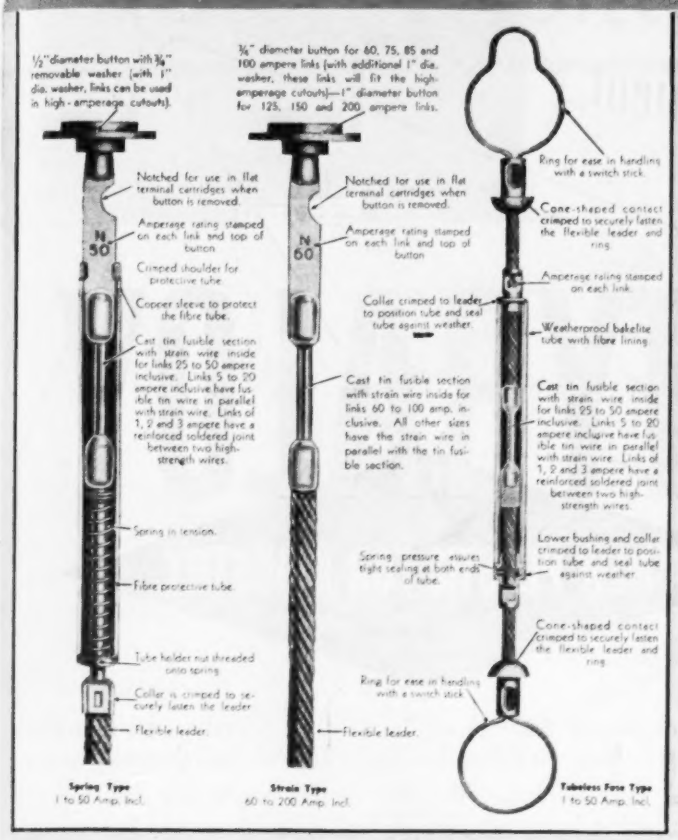
1. **HIGH-VOLTAGE HOOD:** die-cast aluminum; provides ample space for insulation wiring. Various other hoods available to meet all mounting conditions.
2. **RECEPTACLE; SOCKET:** wet or dry process porcelain; for intermediate or high-voltage, multiple or series circuits. Silver-plated contacts and current-carrying parts.
3. **TOGGLE LATCH:** fastens reflector firmly to hood. Sturdy, positive action; large enough for handling even with gloves. *Weatherproof joint;* accurately-machined reflector seat; no gasket necessary.
4. **REFLECTOR:** Alzak Aluminum, scientifically fluted to insure accurate light control; reflects light or radiant energy with sufficient dispersion to prevent it from passing through filament, center stem of some lamps, or arc of type H mercury lamps. *Safety Chain* holds reflector when fixture is serviced.
5. **V-BAND HOLDER:** provides permanent seal between glassware and reflector, but bolts can be loosened to replace glassware in field. Assures positive seal without use of gaskets. *Latch type* holders are also available.
6. **LIGHT SOURCE:** concealed to reduce disturbing glare.
7. **DEFLECTOR:** specular aluminum, furnished with all C-Way refractors for asymmetrical light distribution. Similar deflectors available for use with *globes*.
8. **HOLOPHANE REFRACTOR:** lateral one-piece, distinctive L-M diamond mesh pattern. Also shallow or deep clear or various density globes.

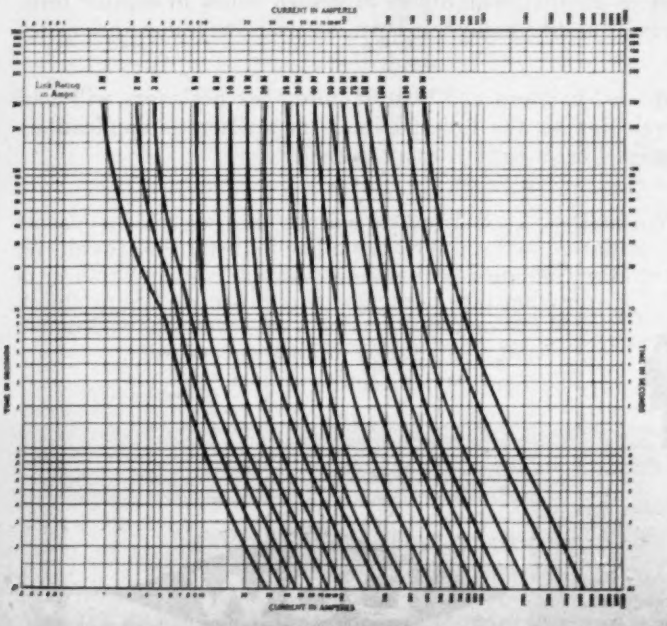
LM

LINE MATERIAL
STREET LIGHTING EQUIPMENT

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers • Fuse Cutouts and Fuse Links • Lightning Arresters • Oil Switches • Pole Line Hardware • Line Construction Specialties • Underground Equipment • Fibre Conduit • Street Lighting Equipment

Better Fuse Coordination—*Easier*


½" diameter button with ⅜" removable washer (with 1" dia. washer, links can be used in high-amperage cutouts).
⅜" diameter button for 60, 75, 85 and 100 ampere links (with additional 1" dia. washer, these links will fit the high-amperage cutouts)—1" diameter button for 125, 150 and 200 ampere links.
Notched for use in flat terminal cartridges when button is removed.
Amperage rating stamped on each link and top of button.
Crimped shoulder for protective tube.
Copper sleeve to protect the fibre tube.
Cast tin fusible section with strain wire inside for links 25 to 50 ampere inclusive. Links 5 to 20 ampere inclusive have fusible tin wire in parallel with strain wire. Links of 1, 2 and 3 ampere have a reinforced soldered joint between two high-strength wires.
Spring in tension.
Fibre protective tube.
Tube holder nut threaded onto spring.
Collar is crimped to securely fasten the leader.
Flexible leader.
Spring Type
1 to 50 Amp. Incl.
Notched for use in flat terminal cartridges when button is removed.
Amperage rating stamped on each link and top of button.
Collar crimped to leader to position tube and seal tube against weather.
Cast tin fusible section with strain wire inside for links 60 to 100 amp. inclusive. All other sizes have the strain wire in parallel with the tin fusible section.
Flexible leader.
Strain Type
60 to 200 Amp. Incl.
Ring for ease in handling with a switch stick.
Cone-shaped contact crimped to securely fasten the flexible leader and ring.
Amperage rating stamped on each link.
Weatherproof bakelite tube with fibre lining.
Cast tin fusible section with strain wire inside for links 25 to 50 ampere inclusive. Links 5 to 20 ampere inclusive have fusible tin wire in parallel with strain wire. Links of 1, 2 and 3 ampere have a reinforced soldered joint between two high-strength wires.
Lower bushing and collar crimped to leader to position tube and seal tube against weather.
Spring pressure assures tight sealing at both ends of tube.
Cone-shaped contact crimped to securely fasten the flexible leader and ring.
Ring for ease in handling with a switch stick.
Tubeless Fuse Type
1 to 50 Amp. Incl.



Time Current Characteristics of L•M Unifit Fuse Links. Average Melting Time.

with wide range of Accurate, Uniform

L•M UNIFIT FUSE LINKS

Here's why . . .

Wide range of types and ratings.

Absolute accuracy and uniformity. Each link individually tested for resistance.

Individually tested for 15 pounds strength.

Rating unmistakably marked in two places for quick selection, ready identification.

Packaged individually for convenience and protection; assures perfect condition.

Backed by 25 years research and development.

The complete range of types and sizes of L-M Fuse Links makes it much easier to get close fuse coordination. You can select from a wide range of ratings in NEMA "N" Rated Links, with flexible leaders, in strain or spring types for all sizes, makes, and kinds of Fuse Cutouts, or with hook-on rings for tubeless cutouts. Get better, easier coordination, more surely. Standardize on L-M Fuse Links—and be sure.

LINE MATERIAL

FUSE CUTOUTS & FUSE LINKS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers • Fuse Cutouts and Fuse Links • Lightning Arresters
Oil Switches • Pole Line Hardware • Line Construction Specialties • Underground Equipment • Fibre Conduit • Street Lighting Equipment

An Important

Plastics Announcement BY DOW

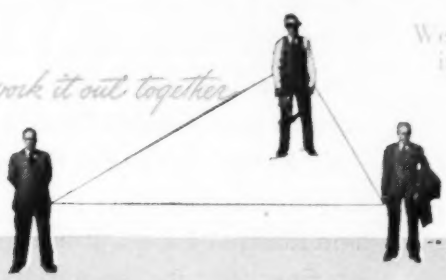
STYRALOY

A NEW PLASTIC FOR INDUSTRY

Highly significant among countless new materials developed for war requirements is Styraloy—trade name for a remarkable group of plastics belonging in a category between rubber-like materials and rigid thermoplastics.

"Working it out together" with the Armed Forces, Dow developed the first of this impressive new line—Styraloy 22—to provide a one-piece cable sheathing with a low power loss at high frequencies and possessing great durability and flexibility. These unique qualities—combined with others presented below in capsule form—point to its use in a broad range of products. As a result, unlike many war-born materials, Styraloy anticipates a peacetime career of great importance.

Now that Styraloy is available for commercial purposes, molders and manufacturers or designers will find Dow equally willing to cooperate with them in developing to the fullest extent the numerous applications indicated by the impressive list of Styraloy's properties. "Let's work it out together."



We at Dow know from experience that success in plastics is not a one-man nor even a one-industry job. It calls for the combined skill and cooperation of manufacturer or designer plus fabricator plus raw materials producer. Working together, this team saves time and money and puts plastics to work successfully. Call us—we'll do our part.

PRESENT AND POTENTIAL USES: One-piece cable sheathing; handles for tools, household appliances, etc.; gaskets; bushings; coil forms; floor mats; scuff plates; many applications still to be ascertained.

PROPERTIES AND ADVANTAGES: High dielectric strength, low power loss over all frequencies. Power factor only .005 at 100-300 megacycles. Flexible and shock resistant from −90° F. to 212° F. Specific gravity less than 1 (floats in water). Water absorption only .2 to .5%. Resists heat, ozone, and most chemicals. Highly resistant to abrasion. Resists permanent indentation. Ideally suited to extrusion of complex cross sections and readily fabricated by other molding techniques. Easily machined.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

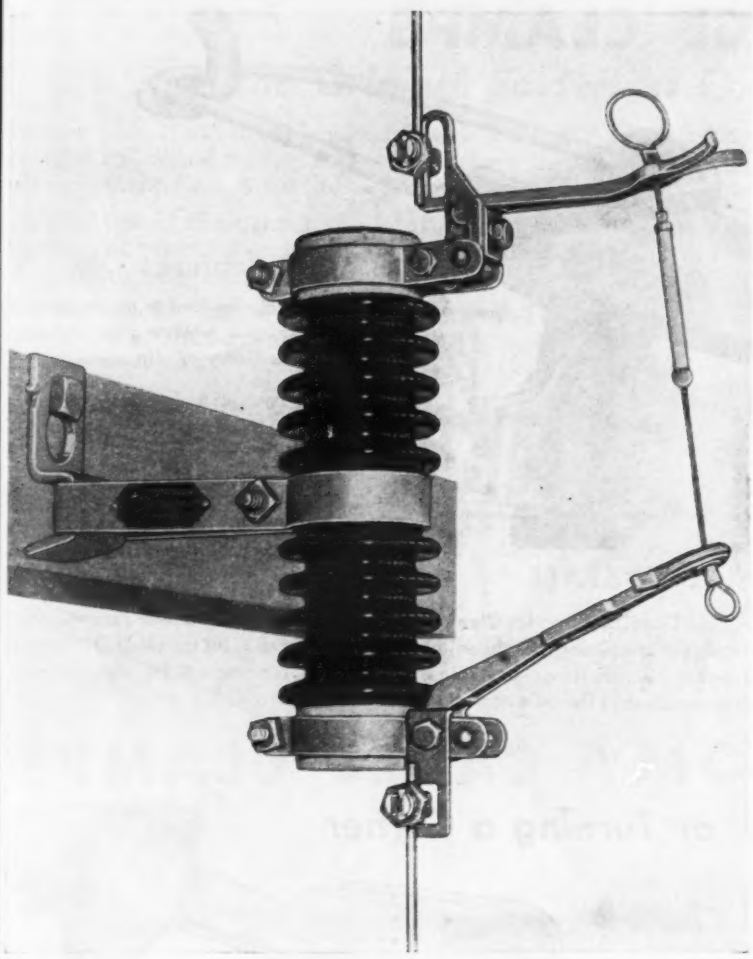
New York • Boston • Philadelphia • Washington • Cleveland • Detroit
Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle

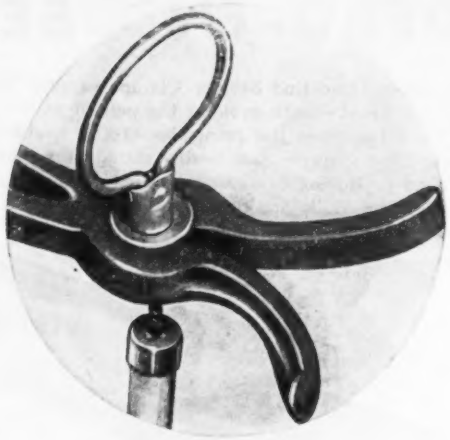
DOW

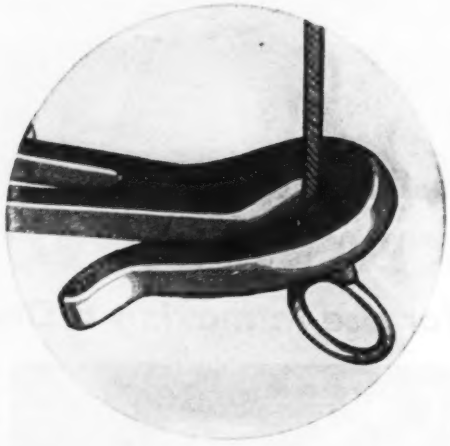
PLASTICS

STYRON • ETHOCEL • ETHOCEL SHEETING
SARAN • SARAN FILM • STRIPCOAT • STYRALOY

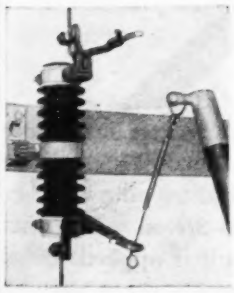
STURDY–LOW COST MATTHEWS PROTECTOLINK CUTOUTS







Catalog 1640-50 Amp. 7.5/12.5 KV. Grd. Y — Catalog 1641-50 Amp. 15 KV.



Write for Bulletin 101-A

The design and ruggedness of Matthews Protectolink Cutouts and Protectolinks insures better performance and lower maintenance costs.

Because of the rigid construction of the contact arms they cannot be easily bent out of alignment when fusing or installing the cutout and the fact that the lower arm is actuated by an individual spring, assures positive contact tension on the Matthews Protectolink.

Note design of the contact ends of the arms. They provide easy installation and automatic seating of Protectolink buttons into the cup shaped contact recesses. No wedging of fuse link into contacts is required, thereby preventing damage to fine wires of fuse link cable. Matthews Protectolink Cutouts will also accommodate any make of open link fuse, and Matthews Protectolink Fuse Links fit other makes of open link cutouts.

W. N. MATTHEWS CORPORATION

SAINT LOUIS, U. S. A.

ENGINEERS and MANUFACTURERS SINCE 1899

There's a KEARNEY Engineered
For any WIRE HOLDING or

DEAD-END SERVICE CLAMPS

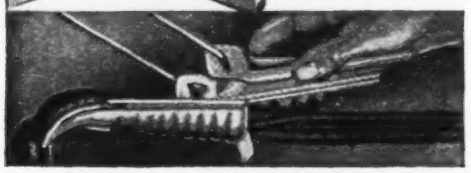
Kearney Dead-End Service Clamps support multiple conductor braid sheath cable at the pole or at the house. The Clamp combines the principles of the snubbing capstan, bolt type clamps, and wedge clamps into one dead-end clamp producing maximum holding power with minimum distortion. Bails are furnished in either solid or flexible wire.

features

Cable is securely snubbed to the wedge of the Clamp, insuring a positive grip and eliminating the possibility of slippage.

Clamp may be installed at any point along the cable without having to thread the cable through the Clamp.

Long, smooth bearing surface places even pressure over entire gripping surface — no high compression points to injure insulation.

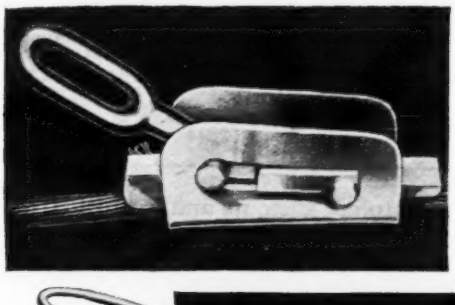


EASY TO INSTALL

Installing the Dead-End Service Clamp is simple and easy. The cable is formed around the lower part of the Clamp and the snubbing clamp tightened on the cable. The grooves of the upper section are then engaged in the lower part, forming a tight-gripping wedge. The bail is attached to the pole or wall and the Clamp is ready for use.

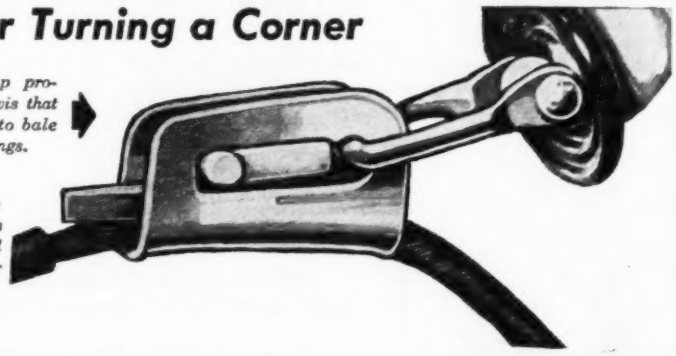
KEARNEY ECONOMY CABLE CLAMPS

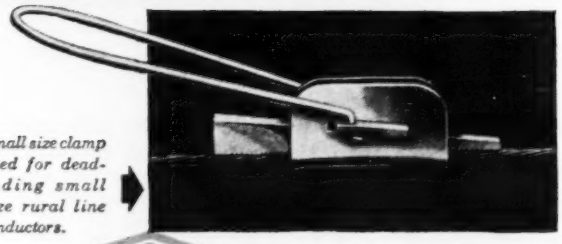
for use in making a Dead-End or Turning a Corner



Economy Cable Clamp provided with a Pin Clevis that permits attachment to bale sockets are similar fittings.

Clamp with eye clevis that permits attachment to ball sockets or similar fittings.





Small size clamp used for dead-ending small size rural line conductors.

These well constructed clamps are used for either dead-ending or turning corners and definitely effect economies since their clamp-wedge design eliminates cutting and tapping of cables. They hold the cable secure by means of a driven wedge which holds the cable more tightly as more pull is applied. Clamp bodies are made of heat treated aluminum — other parts are hot dipped galvanized forged steel.

PRICES AND QUANTITY DISCOUNTS

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

The Mark of Quality Products

KEARNEY PRODUCTS — Designed and Manufactured by

SOLDERLESS WIRE CON-NEC-TITES • TRIP OUT FUSE CUTOUTS AND CONVERSION ASSEMBLIES • TRIP-SAVER FUSE CUTOUTS RECLOSING TYPE • TRIP-O-LINK PORCELAIN HOUSED FUSE CUTOUTS • DOUBLE DUTY FUSE CUTOUTS • TRIP-O-LINK FUSE CUTOUTS • TRIP-O-LINK TRIP-SAVER FUSE CUTOUTS • DISCONNECT SWITCHES • LIGHTNING ARRESTERS • COMBINATION LIGHTNING ARRESTER AND FUSE CUTOUTS • REPEATING FUSE GAP ARRESTERS • ONE TWO INSULATOR FUSE AND DISCONNECT SWITCHES • ROTATING INSULATOR GANG SWITCHES • HOOK OPERATED DISCONNECT SWITCHES • SLIDES SECTIONALIZING CUTOUTS • MULTIPLE STREET LIGHTING RELAY • BY-PASS DISCONNECT SWITCHES • POLE TOP GANG OPERATED SWITCHES • PORCELAIN HOUSED DISCONNECT SWITCHES • OIL CIRCUIT BREAKER • FUSE LINKS • SECONDARY FUSES • FUSE PULLERS • EXPANSION ANCHORS, SCREW ANCHORS, BOLTS TOOLS • FULL-VU GUY GUARDS • GUY WIRE CLIPS AND STRAND BANDS • SLEEVE TWISTERS AND DIES • A.B.C. SLEEVES AND SPLICING MACHINES • DEAD-END SERVICE CLAMPS • FIT-RITE WIRE HOLDERS • "T" CON-NEC-TITES • BUS BAR FITTINGS • RECORDER SELECTOR SWITCH • PHASE ROTATION INDICATORS HI-LINE TOOLS AND ACCESSORIES • CON-NEC-TAP CLAMPS • GROUNDING SETS • TELEPHONE ACCESSORIES

& Manufactured, Quality Product –

VIRE CONNECTING JOB!

KEARNEY CON-NEC-TITES

The Original Solderless Connector

Kearney Con-Nec-Tites pioneered in the field of Solderless Wire Connectors. They feature a full round washer and clean uniform thread which assure maximum pressure between conductors. A lead pilot permits fast and easy starting of the bolts.

Clean thread throughout the length of the bolt assure proper engagement of nut, minimize nut friction and transmit most of the exerted torque into pressure between wires, giving maximum conductivity.

There are 75 Standard Kearney Con-Nec-Tites — in sizes from 1,000,000 CM to the small No. 10 . . . available for either iron, copper or aluminum conductors.

LAP-TITE CONNECTORS

The Kearney Lap-Tite is a sturdy, solderless connector built especially to make quick, safe house service or other similar connections. The body is made of cold drawn compressed copper — screws are made of Duronze. The Kearney Lap-Tite is made in three sizes to handle a range of wire sizes, from two No. 14 wires in the smallest size Lap-Tite to two No. 4 wires in the largest size. Here is a connector that avoids the tendency to bend the wire, since its design puts both wires into pure compression. It is a strong, compact connector made of materials that resist weathering conditions.

SENT ON REQUEST

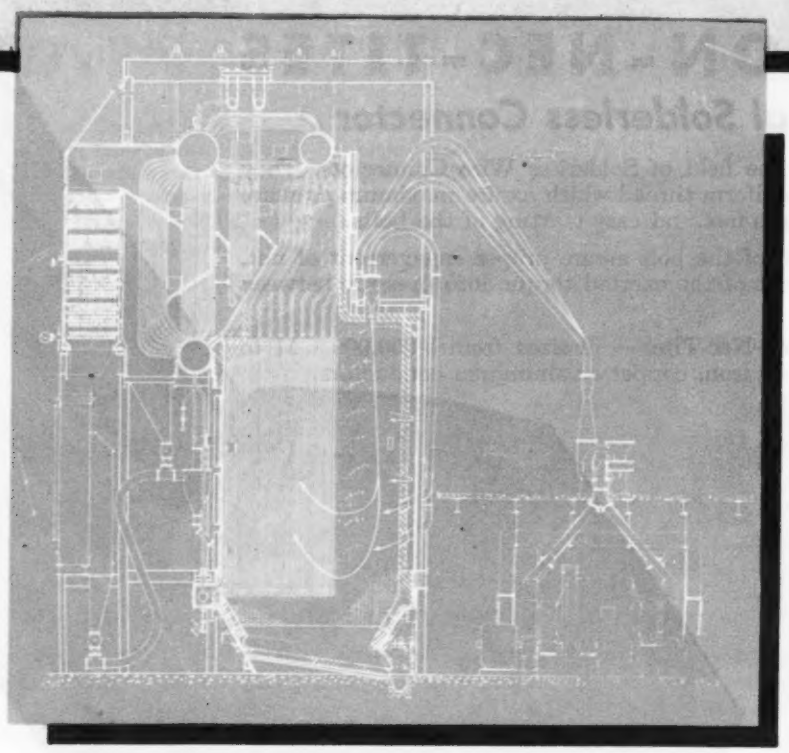
AMES R. KEARNEY CORPORATION

OVERHEAD **UTILITY EQUIPMENT** UNDERGROUND

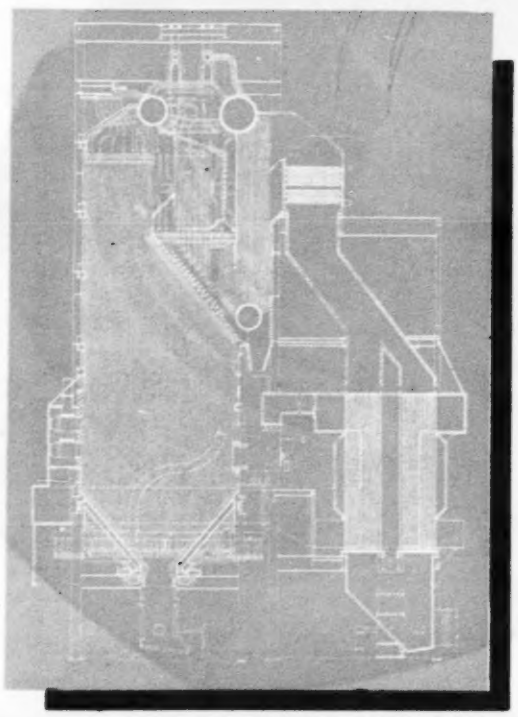
2424-42 CLAYTON AVE., ST. LOUIS (10) MO. • *Canadian Plant:* LEASIDE, ONTARIO, CANADA

STEAM GENERATORS

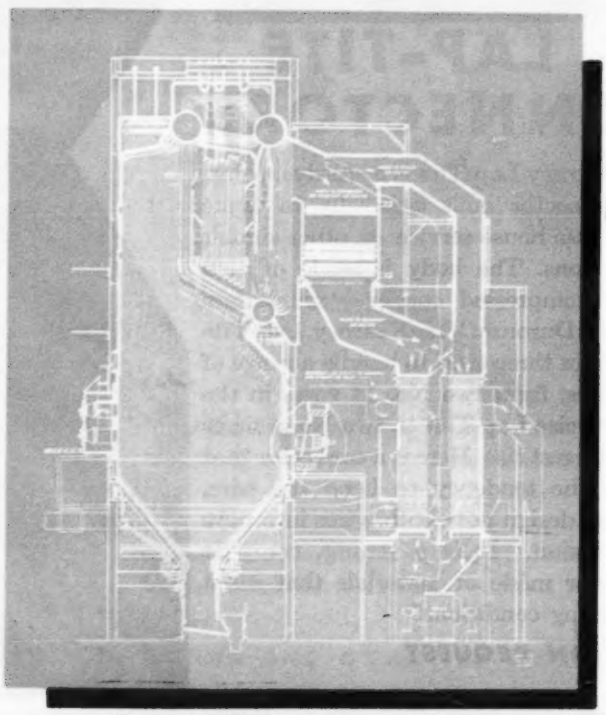
CAPACITIES



Capacity 165,375 lb. steam per hour, pressure 900 psi and final steam temperature 788 deg. F. Fuel: pulverized coal.



Capacity 385,000 lb. steam per hour, pressure 1050 psi and final steam temperature 900 deg. F. Fuel: pulverized coal and blast furnace gas.



Capacity 500,000 lb. steam per hour, pressure 1050 psi and final steam temperature 900 deg. F. Fuel: pulverized coal and blast furnace gas.

FW **FOSTER**

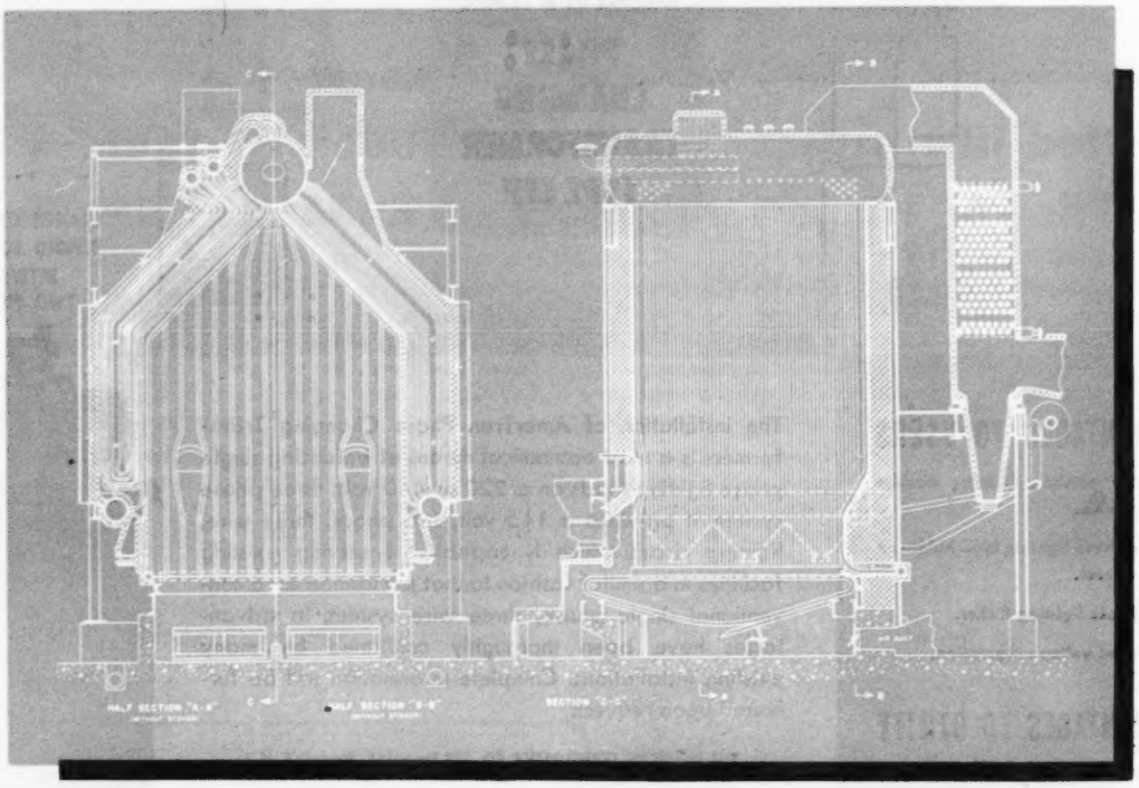
FOR RUSSIA ...

66,000 TO 500,000 LB. STEAM PER HOUR

THE steam generators shown in the accompanying drawings represent 23 of the more than 100 boilers that Foster Wheeler has designed and built for Russia during the past two years.

Their capacities range from 66,000 to 500,000 lb. steam per hour with pressures from 315 psi to 1050 psi and final steam temperatures from 707 deg. F. to 900 deg. F. To accommodate the variety of fuels available, these units are designed for stoker, pulverized coal and blast furnace gas firing.

FOSTER WHEELER CORPORATION, 165 BROADWAY, NEW YORK 6, N. Y.



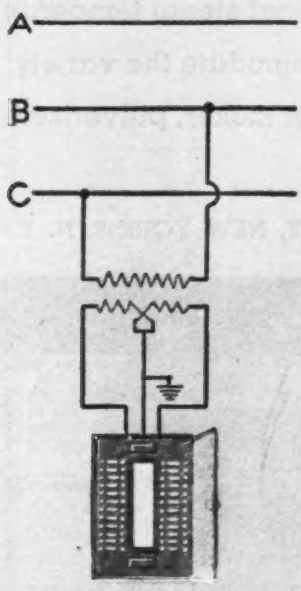
Capacity 66,000 lb. steam per hour, pressure 315 psi and final steam temperature 707 deg. F. Fuel: coal on stokers or blast furnace gas.

WHEELER

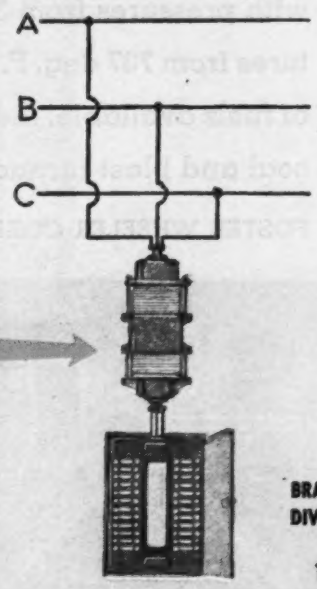
Phase Changing Transformers

OBTAIN THREE PHASE FEEDER BALANCE *With* EXISTING THREE WIRE PANEL BOARD

EXISTING INSTALLATION
(Unbalanced Loading)



MODIFIED INSTALLATION
(Balanced Loading)



AMERTRAN PHASE CHANGING TRANSFORMER TYPE CFP

BRANCH CIRCUITS DIVIDED EQUALLY BETWEEN TWO PHASES

ADVANTAGES TO USERS

Utilizes existing lighting circuits and panels.

Three phase lighting load balanced at low cost.

Minimizes lighting flicker.

Improves voltage regulation.

ADVANTAGES TO UTILITY

More efficient use of existing three phase distribution facilities.

Balanced loading on three phase feeders.

Improved voltage regulation.

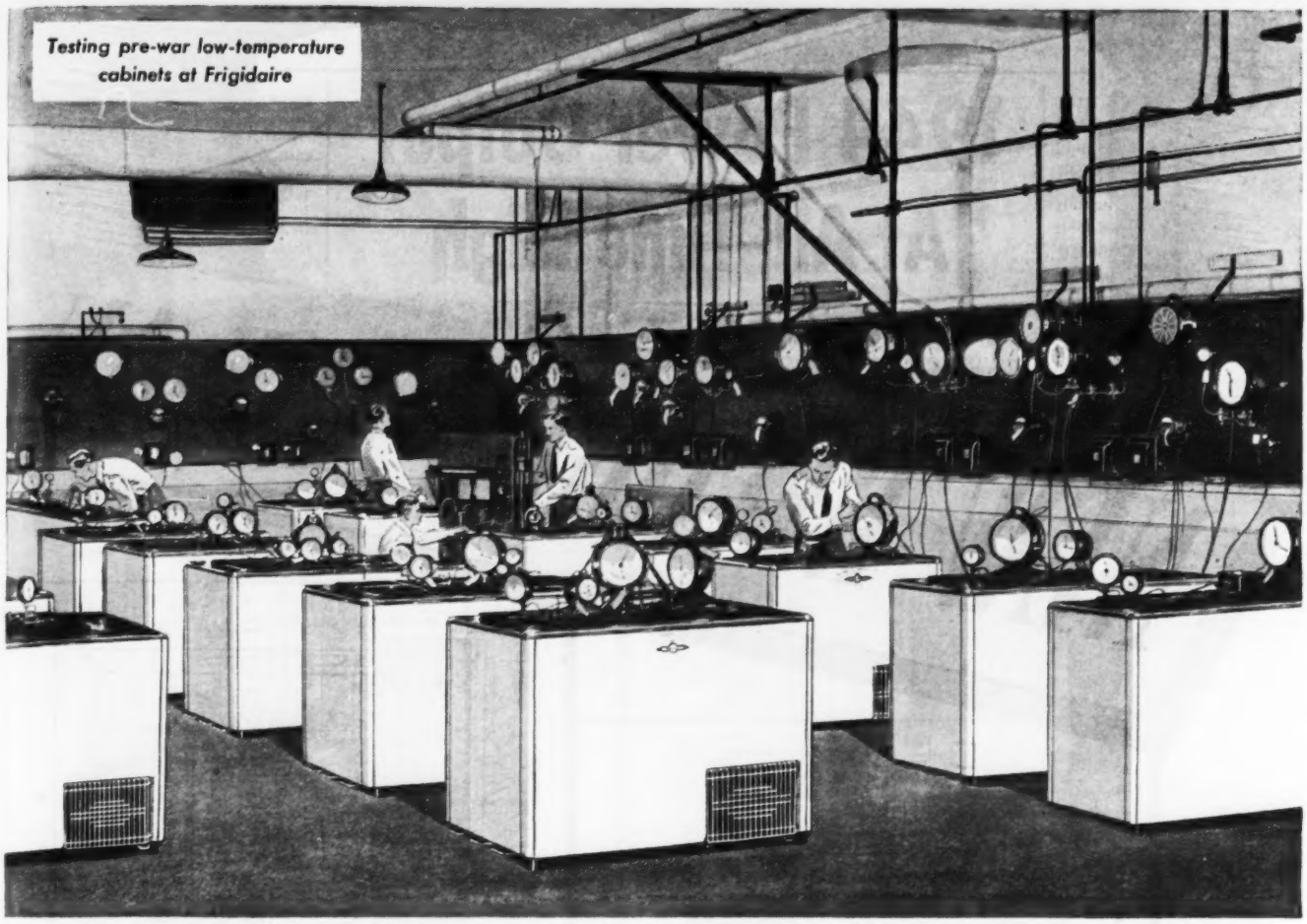
Improved customer satisfaction.

The installation of AmerTran Phase Changing Transformers is a most economical means of balancing single phase lighting loads on a 220 or 440 volt, three phase system. It provides a 115 volt, two phase, three wire, lighting circuit which is capable of serving existing facilities in a similar fashion to that performed by a conventional single phase, three wire system. Its advantages have been thoroughly confirmed by many existing installations. Complete information will be furnished upon request.

THE AMERICAN TRANSFORMER CO., 178 Emmet St., Newark 5, N. J.

AMERTRAN
MANUFACTURING SINCE 1901 AT NEWARK, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission



Testing pre-war low-temperature cabinets at Frigidaire

How does Frigidaire Experience assure still better HOME FREEZERS for Frigidaire Dealers to sell?

TOMORROW'S HOME FREEZERS will reflect the *experience* of the companies that make them. Experience in manufacturing. Experience in research. That's why the Frigidaire Dealer looks forward with confidence to selling the *new* Frigidaire home freezers. For he knows that Frigidaire possesses unmatched experience in the low-temperature field . . .

Experience in Manufacturing. Frigidaire pioneered in engineering low-temperature cabinets . . . for nearly a quarter-century has been manufacturing this type of cabinet, the direct forerunner of the modern home freezer. During this time more than 350,000 such cabinets have been built and sold by Frigidaire —more than by any other manufacturer. And this is in addition to all of Frigidaire's closely related experience in manufacturing equipment for locker plants and general commercial use—and in manufacturing household refrigerators!

Experience in Research. Customer research to determine what prospective users want and expect in home freezers. Frozen food research to check these requirements and to develop maximum "usability" for home freezers. Engineering research to apply the scientific skills of Frigidaire *and* General Motors to designing the finest home freezers possible.

What will the new Frigidaire Home Freezers be like? The answers to that question will be decided in test rooms like the one pictured here. But of one thing you may be sure: Frigidaire experience, allied with Frigidaire facilities, will produce the kind of home freezers the public wants and needs . . . at prices that will mean volume sales for Frigidaire Dealers!

BUY AND KEEP MORE WAR BONDS!

Look to Frigidaire for Leadership through . . . EXPERIENCE

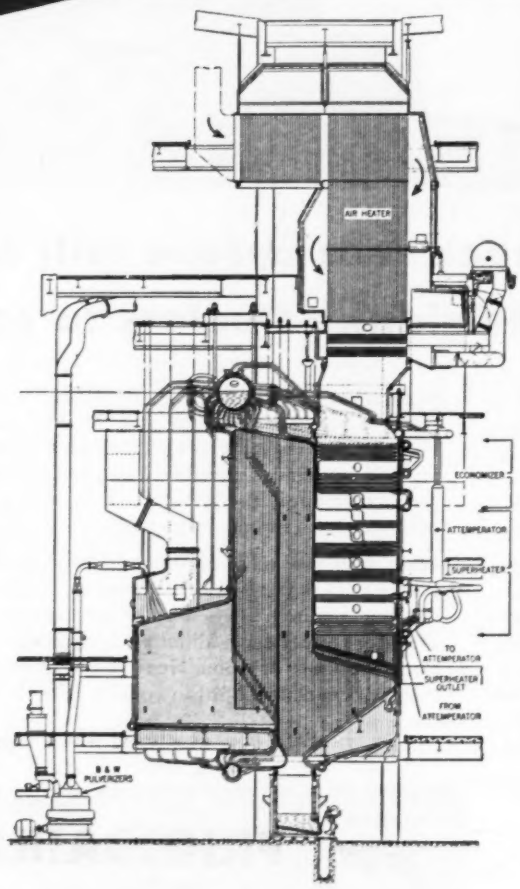
For Excellence in War Production

FRIGIDAIRE
Division of
GENERAL MOTORS
DAYTON 1, OHIO • LEASIDE 12, ONTARIO

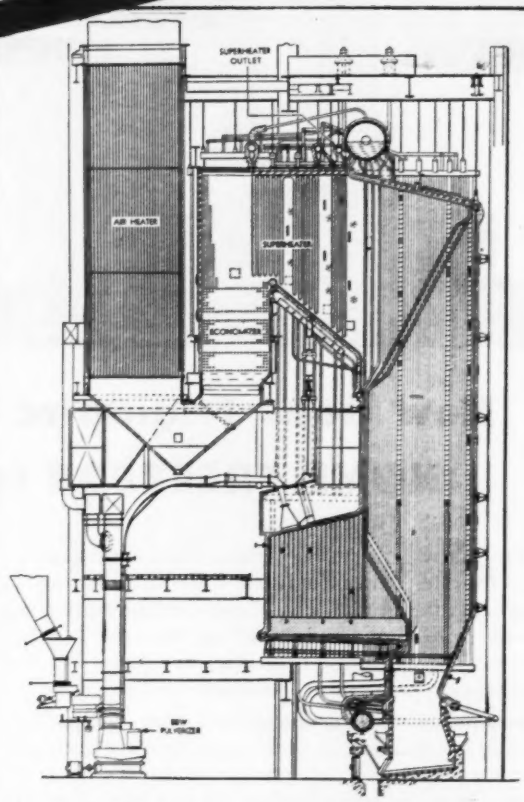
Peacetime builders of
REFRIGERATORS • RANGES • WATER HEATERS
HOME FREEZERS • ICE CREAM CABINETS
COMMERCIAL REFRIGERATION • AIR CONDITIONERS
BEVERAGE, MILK, AND WATER COOLERS

1944 Power Output At All-Time High

NEW RECORDS ARE AN



Open-Pass Boiler in an eastern central-station—capacity 900,000 lb. steam per hr.



Radiant Boiler in an eastern central station—capacity 900,000 lb. steam per hr.

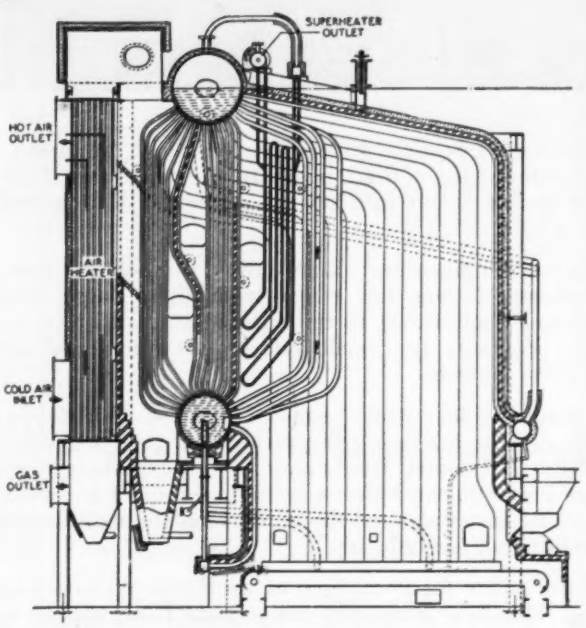
BUY WAR BONDS!

★ ★ ★

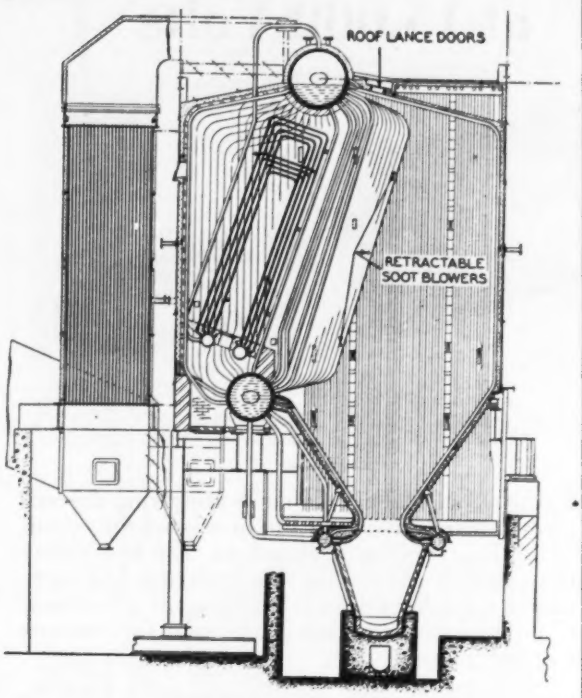
BUY MORE THAN BEFORE

G-295-T

OLD STORY WITH B&W BOILERS



Stirling Boiler in a western manufacturing plant—capactiy 115,000 lb. steam per hr.



Integral-Furnace Boiler in a mid-western steel plant—capacity 169,000 lb. steam per hr.

To managements, engineers, and operating personnel of public utilities and industrial power plants throughout the nation, B&W too, says "WELL DONE" for another year of distinguished war-time achievement.

Your accomplishment in meeting the increased war-urgent power demands for war production and civilian consumers, also added another outstanding chapter to past performance records of B&W Boilers. By providing a large part of your 1944 steam requirements, B&W installations—Radiant, Open-Pass, High-Head, and Integral-Furnace—continued to demonstrate their high availability for service, reliability, and economical performance under unprecedented operating conditions. Along with these more recent B&W designs, Cross-Drum and Stirling boilers also upheld the impressive performance for which they have been so well known for decades.

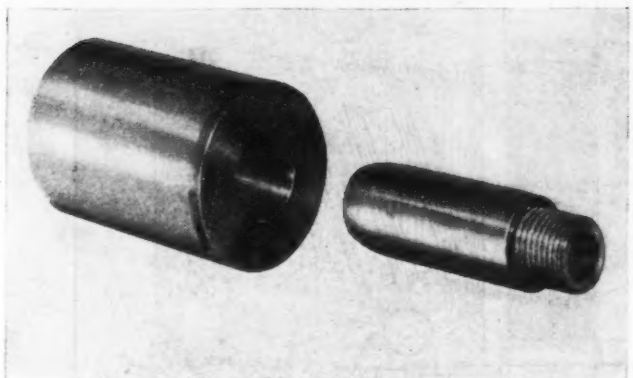
This proved ability of your B&W boilers to deliver large blocks of steam reliably and economically, even under adverse circumstances, is a factor to keep in mind when boilers are needed for future replacements or expansion. It is an indication of how closely B&W designs are matched to the requirements of each job. It is a good reason why you will want to draw again on our long experience in designing, building, and applying steam-generating equipment—experience which cannot be written into specifications or shown on blue-prints, but which is inherent in every B&W Boiler.

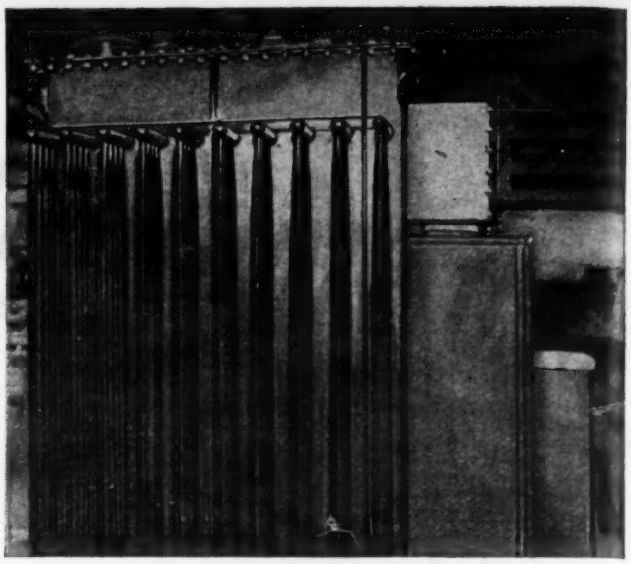
BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.

85 Liberty St., New York 6, N. Y.

MALLORY
Heavy-Duty
CONTACTS
Carry 3,000 Amperes at 15,000 Volts





THOUSANDS of Mallory Contacts are giving dependable performance and long life in oil and air circuit breakers for heavy power applications. The heavy-duty contacts illustrated are required to interrupt and carry 3,000 amperes at 15,000 volts, in a giant oil circuit breaker. To meet these requirements calls for contacts that are plenty rugged!

A "plug-and-socket" type of contact assembly is used. To carry the heavy current, contact surfaces of Elkonite* 3W3, a Mallory refractory metal composition, have been specified on the recommendation of experienced Mallory contact engineers. The plug is made of copper with a complete cover of Elkonite on the contacting surface. The socket is also made of copper, with an insert of Elkonite at the contact point. In the actual installation, the socket is cut into several segments, each mounted on a spring.

Mallory engineering "know-how" for solving contact problems covers the range from these large circuit breaker applications to the most minute silver or tungsten contacts for small relays, electronic and automotive controls.

Consult Mallory while your electronic or electrical product designs are being blueprinted. It pays to come to Mallory—Contact Headquarters—for experienced engineering help, the widest selection of contact and contact backing materials, and the most complete manufacturing facilities in the industry.

Write today for your copy of the Mallory contact catalog. The New Mallory Contact Data Book will be sent gratis to engineers when requested on company letterhead. Available to students, libraries and schools at $2.50 per copy, postage paid.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

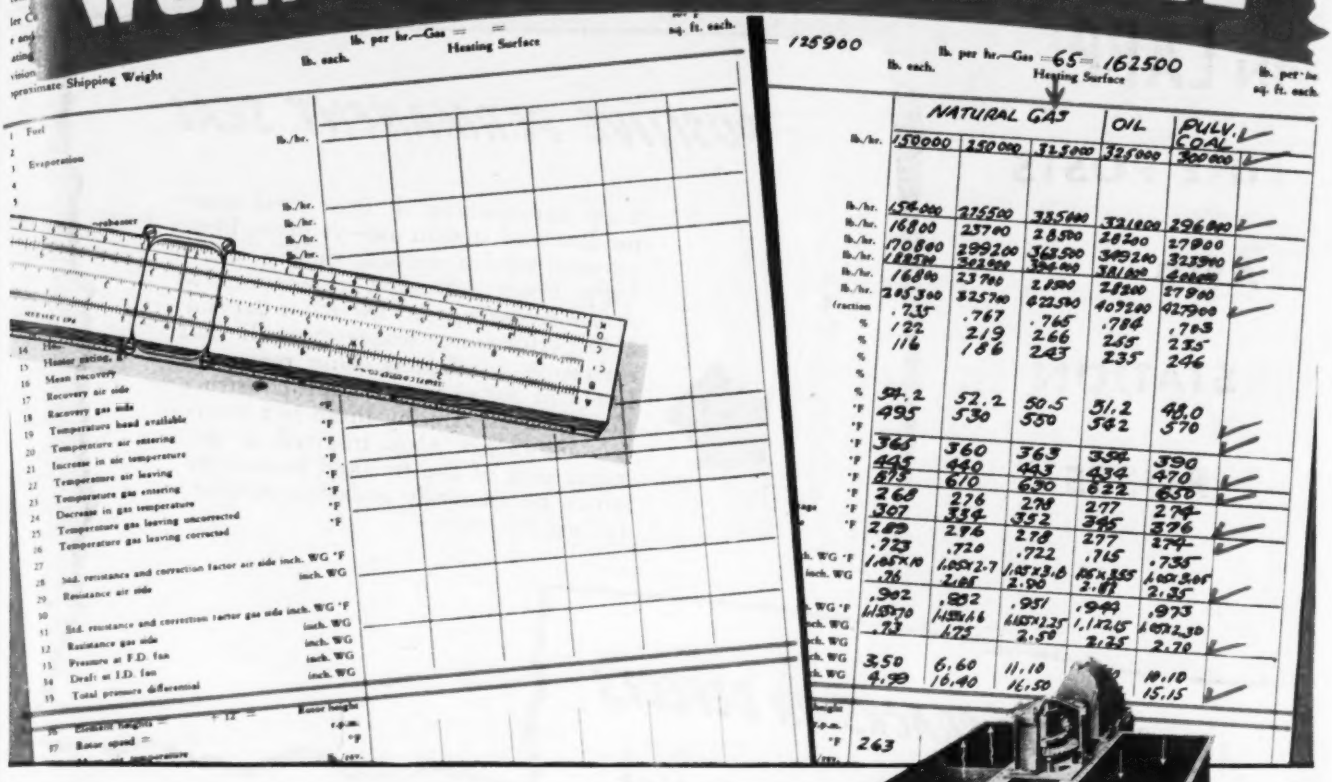
TYPICAL PHYSICAL PROPERTIES OF ELKONITE 3W3

Density: gm.-cc.	13.6
lbs.-cu.in.	.49
Conductivity, % I.A.C.S.	30-35
Hardness, Rockwell B	85-92
Tensile Strength, psi	80,000
Cross Breaking Strength, psi	130,000

Other grades of Elkonite are available with properties adapted to practically all heavy-duty contact applications.

*Reg. U.S. Pat. Off. for electric contacting elements.

WORK SHEETS LIKE THESE



put Preheat Engineering to work on your Heat-Recovery problems

The first step toward putting preheat engineering to work for you is the gathering of data to permit a thorough analysis of your heat-recovery problem. Careful calculations, such as those shown on this sheet, point the way unerringly to *exactly* the right Ljungstrom unit and method of application. Thus, you are certain that your plant is benefitting from all the economies which are possible with the Ljungstrom Air Preheater.

If you are planning to build a new plant, or modernize an old one, you can assure yourself of better heat recovery if you call in a preheat engineer while plans are still in the formative stage.

THE *Ljungstrom* AIR PREHEATER

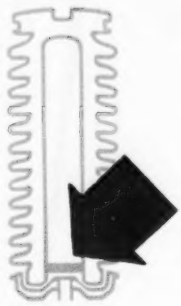
The continuous, regenerative, counterflow principle of the Ljungstrom Air Preheater provides maximum heat transfer with minimum weight and size. The rotating, cylindrical heat transfer surface "soaks up" heat in the gas chamber, then rotates to the chamber where it gives up this heat to the entering air.

THE AIR PREHEATER CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

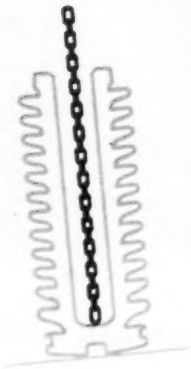
HERE'S THE DOUBLE FACTOR OF SAFETY IN LAPP LINE POSTS AND STATION POSTS

POSITIVE PERMANENT SEAL

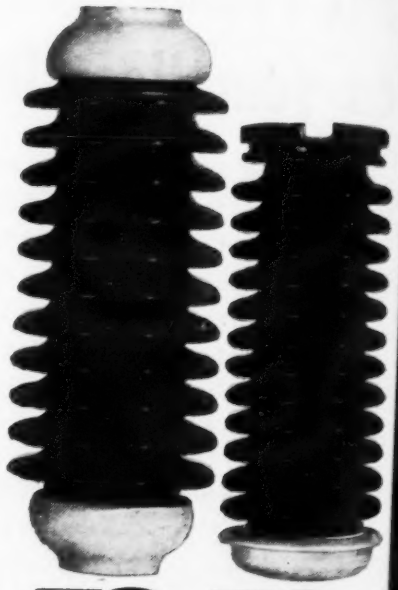


Lapp construction of Post insulators—for line and station use—is proved by a 15-year service record, during which Lapp Posts earned a reputation, *on actual record figures*, for most dependable performance under most difficult operating conditions. One reason is found in the exclusive Lapp construction features. Among these is a *porcelain-and-rubber plug*, inserted at the lower end of the finished porcelain, which permanently seals the interior against moisture.

NO HIDDEN CRACKS OR DEFECTS

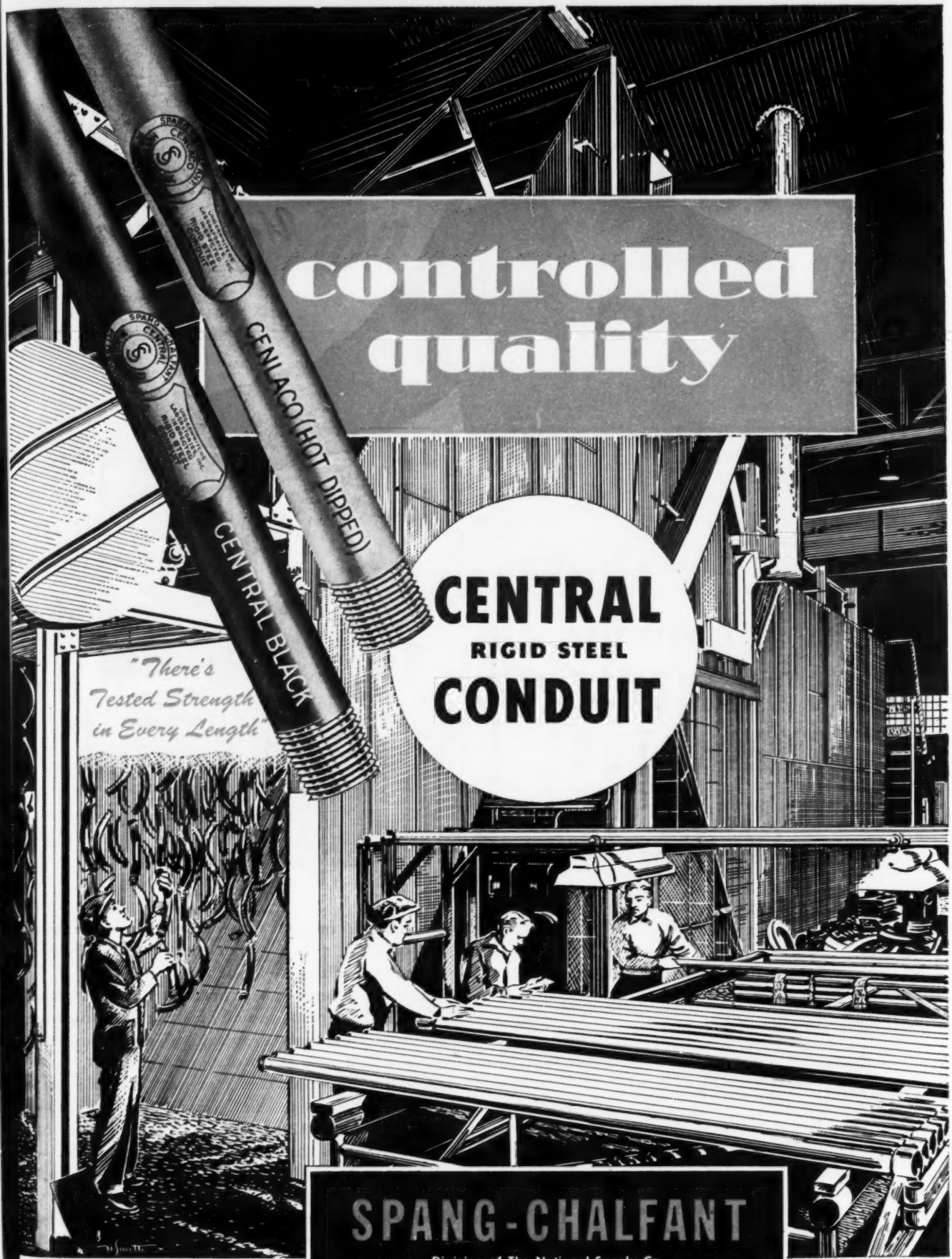


The Post design is considered difficult of production because of the likelihood of internal cracks near the head of the insulator. Lapp production technique prevents this possibility. Each unit is fired as an open-end post; it is visibly inspected outside *and in;* and full flashover voltage is applied across the head section. This double factor of safety avoids puncture or flashover failure in Lapp Line Posts and Station Posts—assures dependable, economical performance on your system.



Lapp

LAPP INSULATOR COMPANY, INC., LE ROY, N. Y.



Scientifically constructed ovens and enameling vats into which are placed "Cenlaco" (Hot Dipped) Conduit for drying of final protective coating — or Central Black Conduit for enamel coating and baking. Non-flaking and uniform coating is an essential requirement for "Central" Conduit.

SPANG-CHALFANT

Division of The National Supply Co.

Executive Offices: Pittsburgh, Pa.

District Sales Offices: Atlanta; Boston; Chicago; Denver; Detroit; Houston; Los Angeles; New York; Philadelphia; Pittsburgh; St. Louis; San Francisco; Tulsa; Washington.

WESTINGHOUSE INSULATING MATERIALS CATALOG

To simplify the selection of the right insulating material, we now have available the new Westinghouse Insulating Materials Catalog 65-000. It contains complete dimensions, ratings and other helpful application data on micas, fabrics, tapes and papers. Ask your Westinghouse Distributor for a copy today, or write Westinghouse Electric & Mfg. Company, P. O. Box 868, Pittsburgh 30, Pa.

Your motors and machines have taken beatings in these war years. Will they be able to meet the new par for electrical efficiency being set by the scores of newly-built war plants?

Your Westinghouse Distributor is equipped to help you make a full electrical check up of your plant, to find out . . . to tell you what's new about a lot of things electrical . . . to suggest ways to revitalize or replace equipment which now is obsolete or inefficient.

"Tuffernell" Insulating Materials are just one example of the completeness of the help he has to offer. For instance, there's the new Thermoset Varnish—No. 8826-1—which offers a longer lease on life to many weary motors than previously was possible. It is typical of hundreds of these "revitalizing materials" that he can supply or is equipped to use, to help you modernize electrically.

Don't gamble on electrical equipment you know is doubtful. Check up . . . revitalize . . . or replace . . . with the help of your Westinghouse Distributor!

J-06368

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Because of the basic importance of adequate wiring to the entire electrical industry, Anaconda is presenting messages like this in a wide list of national publications.

It's a High-Powered Induction Heating Source-

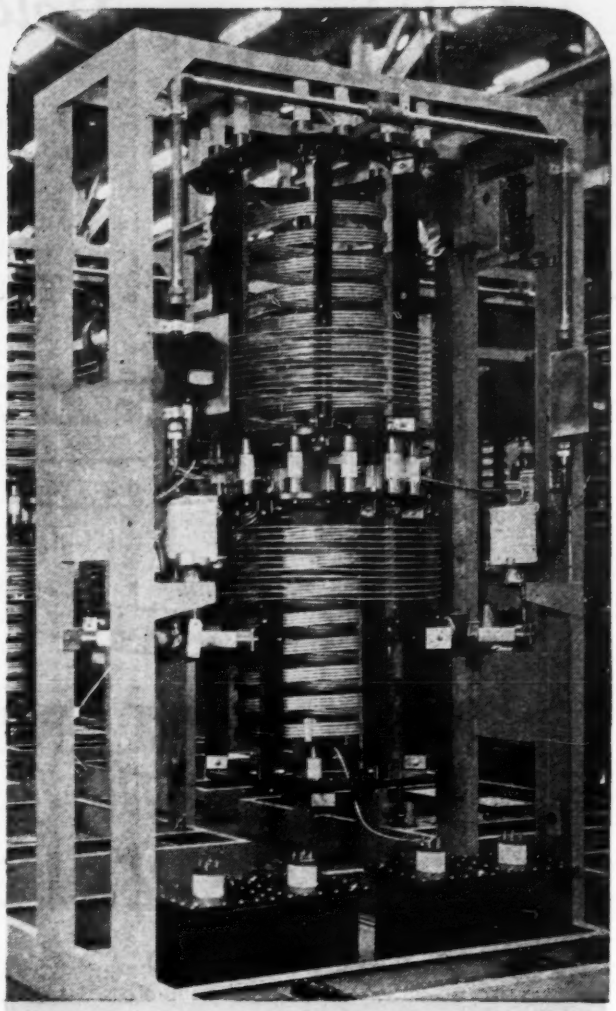
YOU'LL WANT THE PRODUCTION ADVANTAGES OF EQUIPMENT LIKE THIS—

BUT—IS YOUR ELECTRICAL WIRING PLANNED TO CARRY THE LOAD?

New, efficient equipment of every kind promises tremendous postwar production advantages. Don't let lack of electrical capacity bar you from such opportunities.

Make sure your wiring plans are based on *future* needs, not *past* experience. Remember, rush teardowns for alterations will be costly. Wire ahead!

Now is the time—while you're in the planning stage—to call in your consulting or plant power engineer, electrical contractor or power salesman. They'll agree *foresighted* wiring will cost a lot less than the "wait and see" kind.



Westinghouse

In this working component of a high-powered induction-heating unit, brief applications of relatively large amounts of power heat metals from within. Heat distribution is quick, uniform.

ANACONDA

ANACONDA WIRE & CABLE COMPANY

GENERAL OFFICES: 25 Broadway, New York City 4 — *Subsidiary of Anaconda Copper Mining Company*

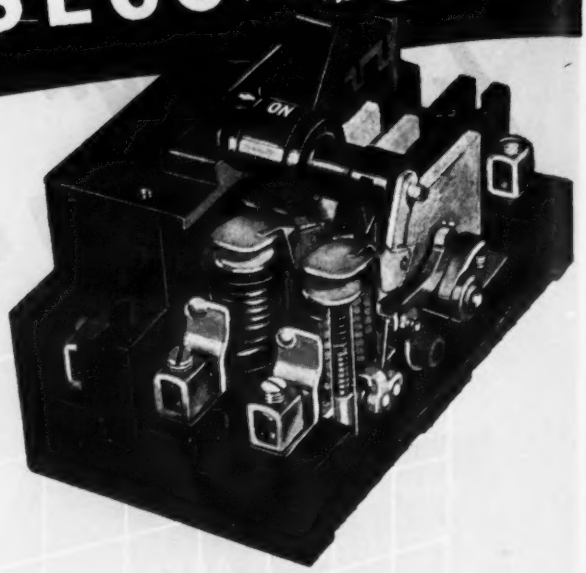
CHICAGO OFFICE: 20 North Wacker Drive 6 • Sales Offices in Principal Cities

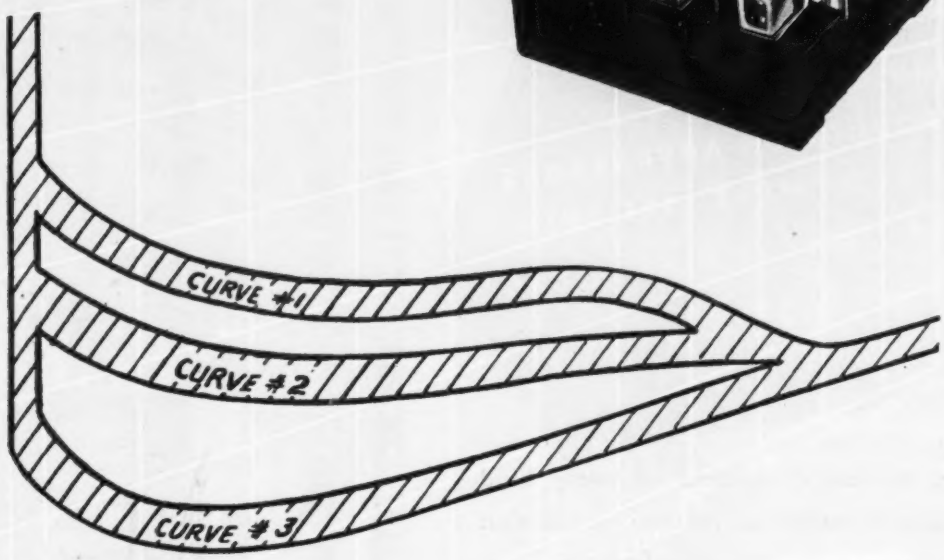
✓ *Check Your Wiring Plans Before They Check You!*

566 SECONDS!

is the

LONGEST Standard Time Delay





HEINEMANN MAGNETIC CIRCUIT BREAKERS

566 seconds is the maximum time which the magnetic breaker will allow to elapse at 25% overload, if the No. 1 time curve is chosen.

There are three standard time curves to choose from in order to match closely the characteristics of the individual application.

The breaker will hold 100% of rated load; may trip between 100% and 125% of rated load; and WILL trip at 125% and above, as shown on the curve. Breakers are available in any rating between 10 milliamperes and 50 amperes with time delay in single, two, and three pole as shown.

The same breaker can also be had with instantaneous trip where current is applied gradually up to rated load. All instantaneous breakers are set to trip instantly.

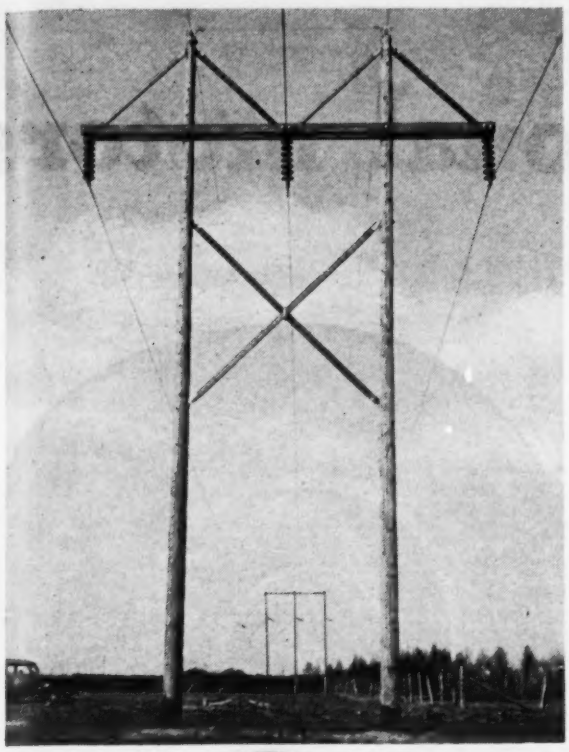
CURVE #1
This is a typical long time delay to overcome the starting inrush of motor.

CURVE #2
This may be the ideal protection for small transformers since the breaker takes care of the relatively fast and high inrush of current when first connected to the line.

CURVE #3
This may be the ideal protection for a filament and plate circuit.

Send for Catalog Showing Complete Line and Engineering Data

HEINEMANN CIRCUIT BREAKER CO.
Subsidiary of Heinemann Electric Co. — Est. 1888
103 PLUM STREET TRENTON, N. J.



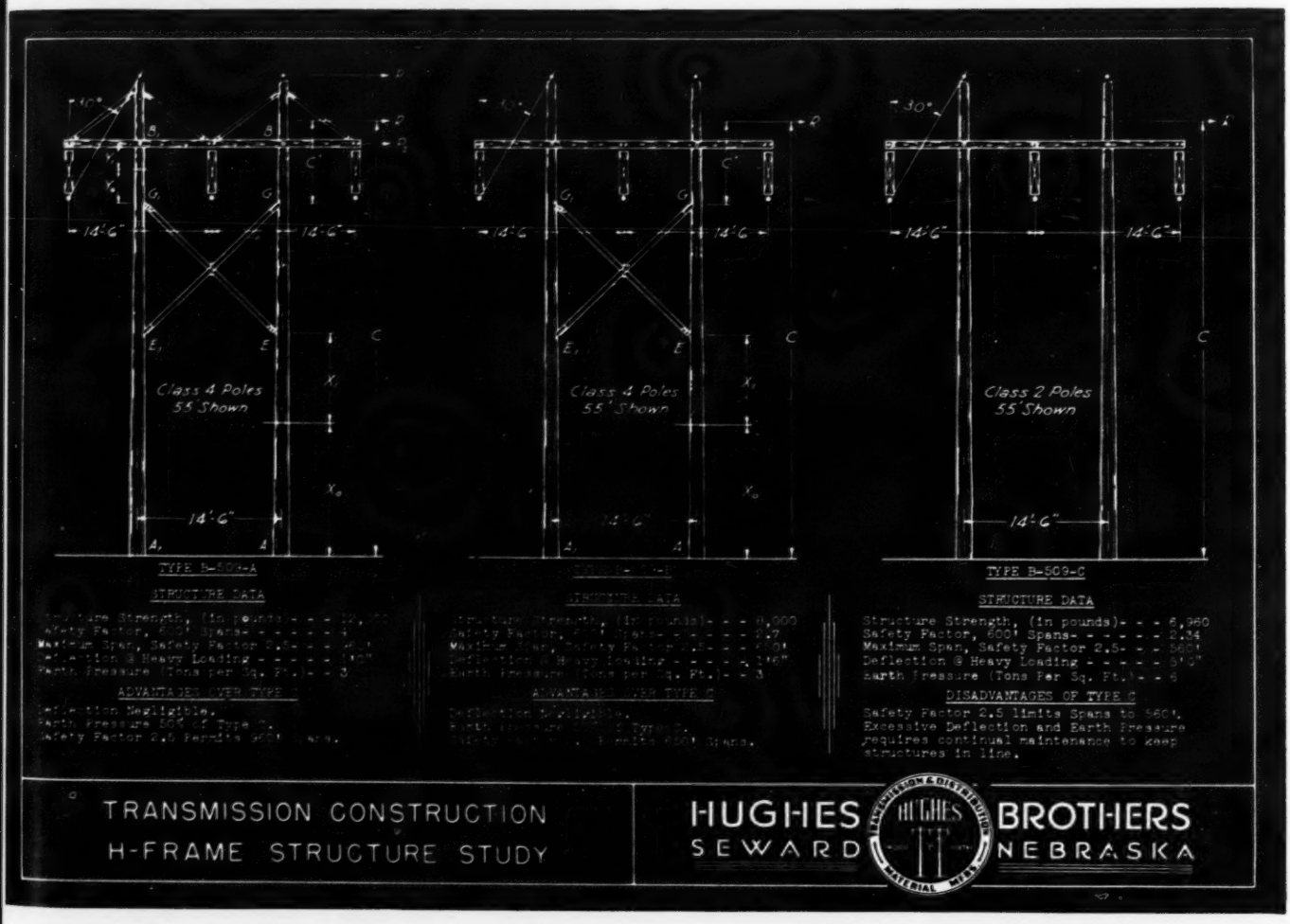
HUGHES BROTHERS
SEWARD NEBRASKA

"HUGHES"
CONSTRUCTION

The most economical completed line is the result of a well braced type of construction, permitting longer spans, fewer structures, fewer insulators, less hardware, less right of way, etc.

The Type A design will usually result in the safest, strongest and most economical long span, high voltage construction. The Knee Braces or inverted cross arm braces permit the pole tops to act as guided cantilevers by introducing a point of inflection between the cross arm and top of the braces. Without Knee Braces, the poles above the X-Braces act as simple cantilevers.

Guy Wires will not substitute as internal bracing for "X" or "K" Braces. The tension guy only is effective and the load is, therefore, all on one pole.



TYPE B-509-A

STRUCTURE DATA

TYPE B-509-C

STRUCTURE DATA

Structure Strength, (in pounds) - - - 6,960
Safety Factor, 600' Spans- - - - - - 2.34
Maximum Span, Safety Factor 2.5- - - - 560'
Deflection @ Heavy Loading - - - - - 9'0"
Earth Pressure (Tons Per Sq. Ft.)- - - 5

DISADVANTAGES OF TYPE C

Safety Factor 2.5 limits Spans to 560'.
Excessive Deflection and Earth Pressure requires continual maintenance to keep structures in line.

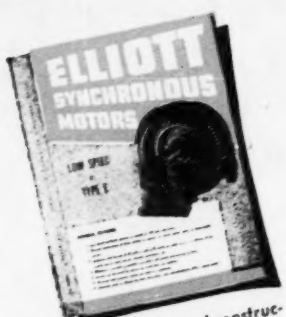
TRANSMISSION CONSTRUCTION
H-FRAME STRUCTURE STUDY

HUGHES BROTHERS
SEWARD NEBRASKA

Two exceptional motors

Low-speed synchronous—Type E

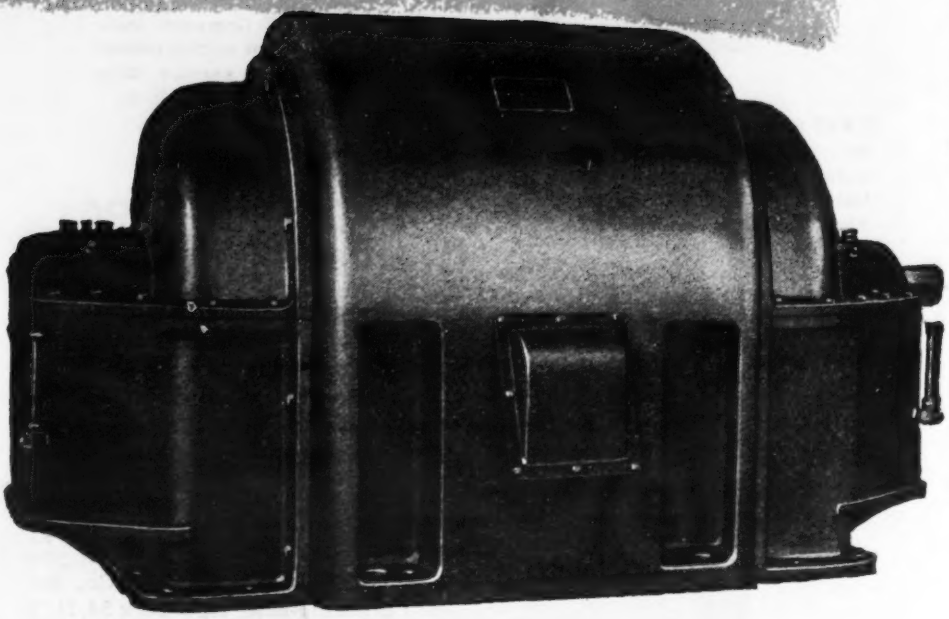
- Operates at 450 rpm and below—
- Squirrel cage windings in rotor of famous Elliott diamond cage type where required—
- Windage and magnetic noises are kept to a minimum—
- Motors are specially adapted and built for their specific service—
- Efficiency as high as possible consistent with good engineering practice—
- Materials used are the best obtainable . . . workmanship is uniformly of highest standard—
- THESE ARE EXCEPTIONALLY STURDY MOTORS, RECOMMENDED FOR LOW-SPEED DRIVES, WHERE MANY YEARS OF SERVICE ARE CONTEMPLATED.



Many exceptional construction features covered in the new bulletin — Write.

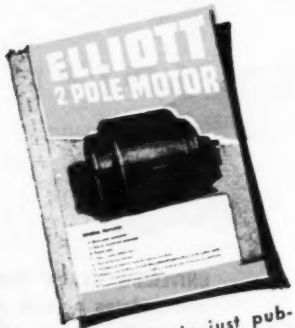
ELLIOTT

by ELLIOTT



high-speed two-pole— splash-proof

- Smooth, streamlined appearance—
- Substantial cast iron frames and brackets—quiet, stiff, vibrationless—
- Rotor bearings rigidly braced from base—
- Rotor carefully balanced dynamically and statically—
- Rotor winding designed for the service required. Elliott diamond cage construction used where exceptional strength is needed—
- Substantial, roomy conduit box—
- Construction minimizes windage and magnetic noises—
- Controlled ventilation assures cool operation—
- A PARTICULARLY SERVICEABLE HIGH-SPEED MOTOR, BUILT TO ELLIOTT STANDARDS THROUGHOUT.



New bulletin just published, covers interesting construction details. Write.

L-761

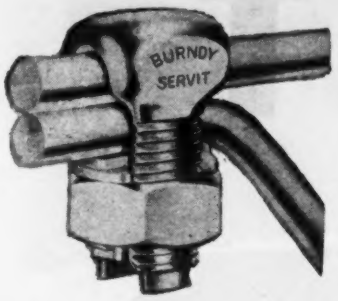
COMPANY

Electric Power Department

RIDGWAY, PA.

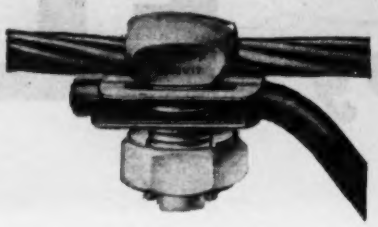
DISTRICT OFFICES IN PRINCIPAL CITIES

MAKERS OF: STEAM TURBINES • GENERATORS • MOTORS
CONDENSERS • FEEDWATER HEATERS AND DEAERATORS
STEAM JET EJECTORS • CENTRIFUGAL BLOWERS • TURBO-CHARGERS FOR DIESEL ENGINES • TUBE CLEANERS
STRAINERS • DESUPERHEATERS • FILTERS



SERVIT (Type KS) Forged for High Strength. For copper and Copperweld conductors. 13 sizes take from No. 10 solid to 1000 Mcm. Also available in aluminum.

BUTTIN (Type KP) Compact, inexpensive; ideal for making connections between service drop conductors and entrance leads.



SERVIT (Type KSAKF) For aluminum to copper connections. Consists of High Strength aluminum Servit with bimetallic Copral washers to keep similar metals in contact.

Connectors for Overhead Distribution

Rural or Urban

Burndy *makes them all* . . . in sizes and types for every rural or urban overhead need . . . for either copper or aluminum conductors. All provide the high strength, corrosion resistance, electrical efficiency, and the installation ease essential for efficient, low-cost overhead service. Catalog gives complete description. Send for your copy . . . Burndy Engineering Co., Inc., 107-J Bruckner Blvd, New York 54, N. Y.

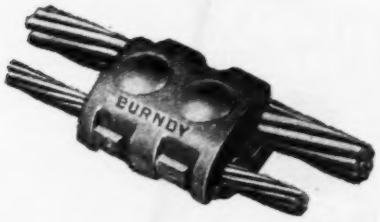
Headquarters for CONNECTORS

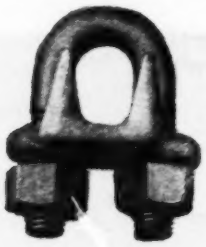
Burndy

In Canada: Canadian Line Materials, Limited, Toronto 13.
Foreign: Philips Export Corporation, 100 E. 42nd Street, New York 17, N. Y.

REDHEAD (Type HR) Completely insulated live-line jumper clamp for use in pairs with a flexible connecting cable for shunting equipment.

HOTTAP (Type HTE) A well balanced hot-line tap for low-cost work. Eye-bolt fits standard hot-line sticks. Available for copper or aluminum conductors. Also heavy duty types.

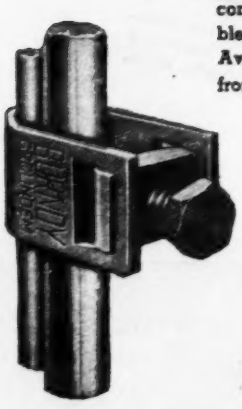




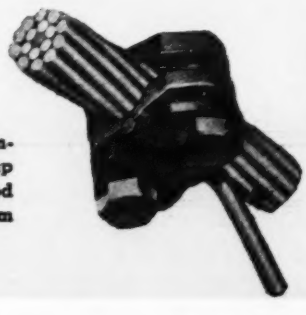
CLIP (Type BC) Bronze Clips for dead-ending work. Available in 9 sizes, for copper wire sizes No. 4 to 750 Mcm . . . and guy wire sizes ¼" to 1".

UNIVERSAL CLAMP (Type UC) Accommodates a large range of cables and wires in either groove. Available in 6 sizes to handle from No. 6 solid up to 1000 Mcm.

TAP CONNECTOR (Type KVS) Strong, compact, quickly installed. Multiple bolts for high contact pressures. Five sizes take from No. 4/0 Str. to 1000 Mcm.



GROUNDEM (Type GN) An economical, non-corrosive ground clamp for driven rod or pipe. Slipped over top of rod or installed from the side.



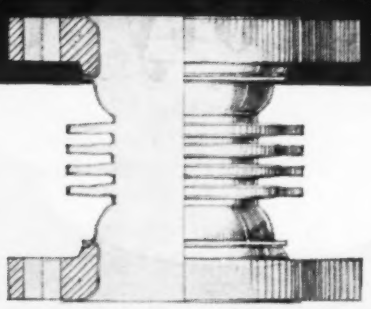
ARMOR ROD CLAMP (Type BPG) For tapping from a run of ACSR protected by armor rod. Has heavy spring plate to keep conductors under constant pressure.

A NEW Expansion and Pressure Member...

Specifications

1. End flanges 150 lbs. standard forged steel ASA requirements. ASTM and ASME specifications.
2. Van Stone lap, slip style, for self alignment of end flange bolt holes.
3. Face to face dimensions 6" O.A. free length.
4. For vacuum service. Micron tight.
5. For pressures ranging from 0 to 55 lbs. p.s.i.
6. Total travel of bellows illustrated ½", can be used on compression or expansion.
7. Spring rated bellows provide uniform travel.
8. Long life. Cycleage in average use upwards of 10^6.
9. Temperature range—300°F. to 900°F.
10. For corrosive gases or liquids.

Available in standard pipe sizes from 2" to 6" inclusive, they can be supplied with additional bellows flanges for greater travel ranges. Face to face dimensions increase accordingly. When ordering specify type of service and whether used for vacuum or pressure applications. These bellows are designed for specific services and applications. All prices quoted on request.



MAGNI LASTIC

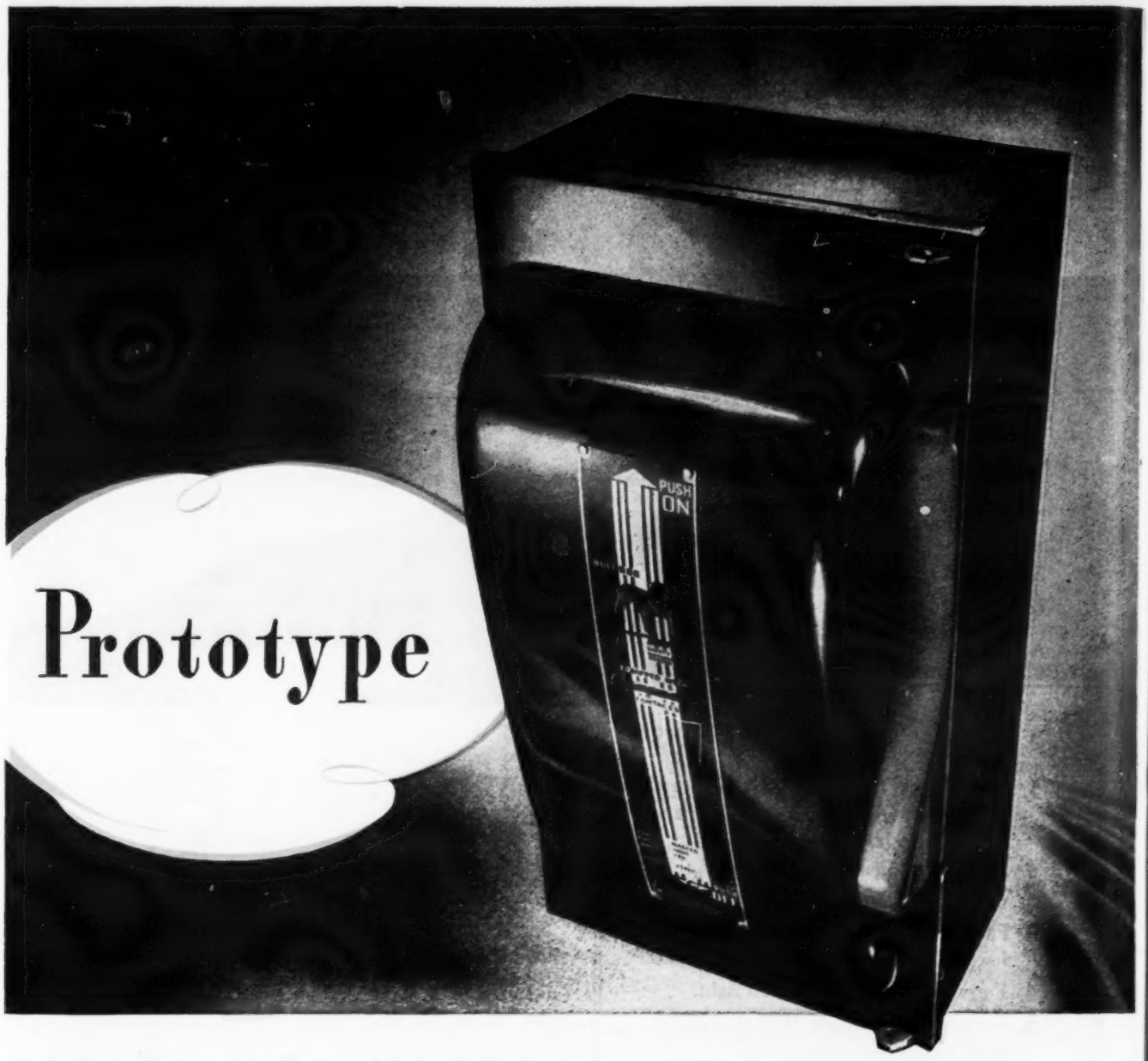
EXPANSION JOINTS

Here is a new, vacuum and medium pressure, expansion joint recently developed by Cook Electric Company, made of Monel metal. It responds to hand pressure flexing, yet is capable of meeting all of the requirements as listed in the specifications at the left. It is used for chemical, diesel, oil, special process and steam line applications.

MagniLastic bellows, through their use of all metals and modern metal joining techniques, can be incorporated into many advanced industrial units. Let MagniLastic solve your unusual bellows problems.

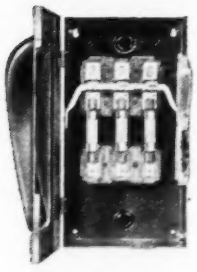
COOK ELECTRIC Company

2700 SOUTHPORT AVENUE • CHICAGO 14, ILLINOIS



Prototype

Vacu-Break SAFETY SWITCH WITH "CLAMPMATIC" CONTACTS



A *Prototype*, the dictionary says, "is an original model after which anything is copied."

Measured by that definition, the BullDog Vacu-Break Safety Switch, with its many advanced features, is definitely the *prototype* of tomorrow's designs.

The exclusive Vacu-Break principle of arc suffocation—the Clampmatic feature which assures contacts tight as a bolted connection—new, simplified operating mechanism—modern streamlined design and attractive appearance—are but a few of tomorrow's safety switch features which are exclusive in the BullDog Vacu-Break Switches of today.

These *prototype* BullDog features are your guarantee against obsolescence, as well as your assurance of top performance at minimum cost right now!

Capacities from 30 Amp. to 1200 Amp. Write for illustrated folder.

BUY WAR BONDS

SALVAGE PAPER

BULLDOG

ELECTRIC PRODUCTS COMPANY

BOX 177, R. PK. ANNEX, DETROIT 32, MICHIGAN. In Canada: BullDog Electric Products, Ltd., Toronto. Field Engineering Offices in All Principal Cities.

Also Manufacturers of

SafToFuse Panelboards—Switchboards—Circuit Master Breakers — BUStribution DUCT, for "plug-in" power — Universal Trol-E-Duct, for flexible lighting—Industrial Trol-E-Duct, for movable "loads."

BH EXTRA FLEXIBLE FIBERGLAS SLEEVING

MAKE THIS
FLAME TEST
Hold a match under a piece of BH Extra Flexible Fiberglas Sleeving. The flame does not burn, char or otherwise affect it. And temperatures much higher than usually encountered electrically are just as readily resisted by the inorganic Fiberglas!
BH EXTRA FLEXIBLE FIBERGLAS SLEEVING
2 WAYS BETTER
NON-FRAYING • NON-STIFFENING

FEW electrical insulations can double in brass as heat insulations. Yet so effectively heat resistant is BH *Extra Flexible* Fiberglas Sleeving that actual service records show it refuses to burn even in direct contact with heat units. The reason—both yarns *and* impregnation are non-inflammable!

A special gum base and dye applied by an exclusive BH process is responsible for many more features. It permanently *prevents fraying, stiffening and abrasive wear.* The sleeving is unusually flexible and takes the roughest handling without fraying. It does not harden and crack with age—lasts indefinitely without deterioration. It is also non-crystallizing at low temperatures.

Fiberglas is non-absorbent and unaffected by moisture, oil or grease—qualities ideally suited to appliance manufacture for instance. And it has high dielectric and tensile strength.

"Punishment" tests prove that BH *Extra Flexible* Fiberglas Sleeving is the most logical insulation for a host of tough jobs. Why not see for yourself? It's available in all standard colors and all sizes from No. 20 to 5/8", inclusive. Write for samples today and compare!

BH SPECIAL TREATED FIBERGLAS SLEEVING UNAFFECTED BY HEAT UP TO 1200°F!

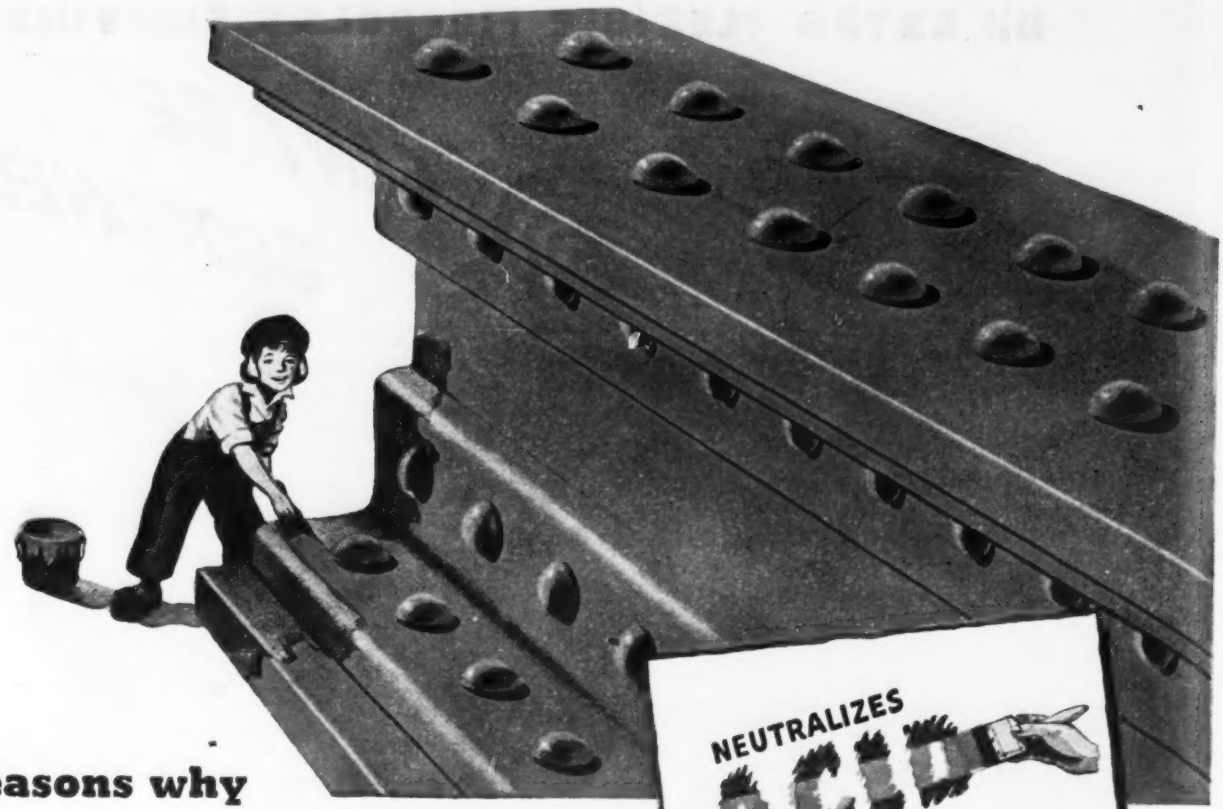
This is a high quality sleeving that will not fray when cut and withstands heat up to 1200°F. Yet no saturant is used in the exclusive BH process! Flexible as string, too. Made in natural color only—all standard sizes. Try it!

BH PRODUCTS

ALSO SLOW-BURNING IMPREGNATED ARMATURE TUBING • SLOW-BURNING FLEXIBLE VARNISHED TUBING • SATURATED AND NON-SATURATED SLEEVING

BENTLEY, HARRIS MANUFACTURING CO.

Dept. W Conshohocken, Penna.



2 Reasons why

RED LEAD

means Extra Rust Protection . . .

Why is Red Lead so widely accepted throughout industry as *The* metal protective paint?

Why are paints containing Red Lead so generally specified for safeguarding metal surfaces from the costly ravages of rust?

The reasons are many, but none are more noteworthy than Red Lead's ability to counteract acid conditions and to halt electrochemical action—both prime causes of rusting—as explained at right.

Still another important advantage of Red Lead is that it partially combines with the usual vehicles to form compounds generally known as "lead soaps." Due to their composition and the individual way in which these compounds form, the film obtained is highly water-resistant. In addition, lead soaps contribute to the formation of tough, elastic films that "stick on the job."

Remember, too, that Red Lead is compatible with practically all vehicles commonly used in metal protective paints, including phenolic and alkyd resin types.

Specify Red Lead for ALL Metal Paints

The value of Red Lead as a rust preventive is most fully realized in a metal paint where it is the only pigment used. However its rust-resistant properties are so pronounced that it also improves any multiple pigment paint. No matter what price you pay, you'll get a better metal paint if it contains Red Lead.

NEUTRALIZES ACID

1 Red Lead has the ability to counteract acid conditions which are recognized as accelerators of rust. Structural steel is exposed to such environments because acid forming compounds are carried by the atmosphere in the form of gas, smoke and moisture. Red Lead has a neutralizing effect on these conditions as it is essentially a *basic* pigment with the ability to develop and maintain, for a prolonged time, a mild alkaline environment at the surface of the metal. Authoritative tests show that, as a result, Red Lead inhibits the process of corrosion. In short, metal paints, too, should "stay on the alkaline side."

2 Another outstanding reason Red Lead means *extra* rust protection is the unique way it shields metal surfaces with a protective film. Rusting is fundamentally an electrochemical process in which weak currents are generated which cause iron to become soluble in the lowest state of oxidation. Red Lead has properties through which this iron is rapidly converted to a stable compound that forms an adherent film. The formation of this protective shield halts electrochemical action, thus preventing further corrosion.

Write for New Booklet

"Red Lead in Corrosion Resistant Paints" is an up-to-date, authoritative guide for those responsible for specifying and formulating paint for structural iron and steel. It describes in detail the scientific reasons why Red Lead gives superior metal protection. It also includes typical specification formulas. If you haven't received your copy, address nearest branch listed below.

* * *

The benefit of our extensive experience with metal paints for both underwater and atmospheric use is available through our technical staff.

NATIONAL LEAD COMPANY: New York 6, Buffalo 3, Chicago 10, Cincinnati 3, Cleveland 13, St. Louis 1, San Francisco 10, Boston 6 (National-Boston Lead Co.); Pittsburgh 30 (National Lead & Oil Co. of Penna.); Philadelphia 7 (John T. Lewis & Bros. Co.)

DUTCH BOY RED LEAD

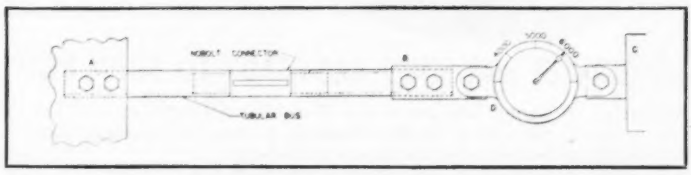
Save 3/4 or More Installation Time with **SHELDON NOBOLT CONNECTORS** *for Tubular Buses*

You get *permanent,* vibration-proof electrical connections on tubular buses with SHELDON NOBOLT CONNECTORS ...at only ¼ *or less* the installation time and cost of other types!

Using a new, patented principle, high internal expanding pressure is exerted by wedges sliding in grooves and forcing the serrated halves of the connector against the inside of the tubular bus. Wedges and grooves are machined at a carefully calculated angle to give maximum locking pressure.

SHELDON NOBOLT CONNECTORS come in all sizes from ½ to 5 S.P.S. in Couplers, Elbows, Terminal Lugs, Reducers, Tees, Clamp Type Tees, Stud Connectors and Expansion Couplers. Write today for catalog and data book. Sheldon Service Co., 652 Hudson St., New York 14, N. Y.

***WITHSTANDS 6000 LB. PULL!**



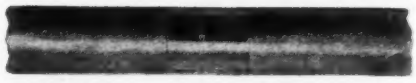
Tubular bus with Nobolt Connector is anchored at (A) and connected to tension gauge at (B). Pull is exerted by motor (C) and measured by tension gauge (D). Against 6000 pound pull, Nobolt Connectors don't pull out or vibrate loose.

[*1¼" S.P.S. Tubing]

Slide connector into end of one tubular bus

Slide Joining Tubular bus over other end of connector

Force wedges apart by hammering steel tapered key (furnished free) and a perfect electrical and mechanical connection is made



Completed connection. Note neat and smooth appearance making for easy insulation

Specify "Sheldon" for Precision-Built Electrical Connectors

SHELDON SERVICE COMPANY

SPLITBOLTS ... LUGS ... COUPLERS ... LIMITERS ... CRABS

for low operating and maintenance cost on RURAL LINES...use Wagner Self-Protected Transformers

The use of Wagner type HEBF-P Self-Protected Rural-Line Transformers assures important savings in operation and maintenance because of their improved design, high-quality construction, ease of installation, and high efficiency.

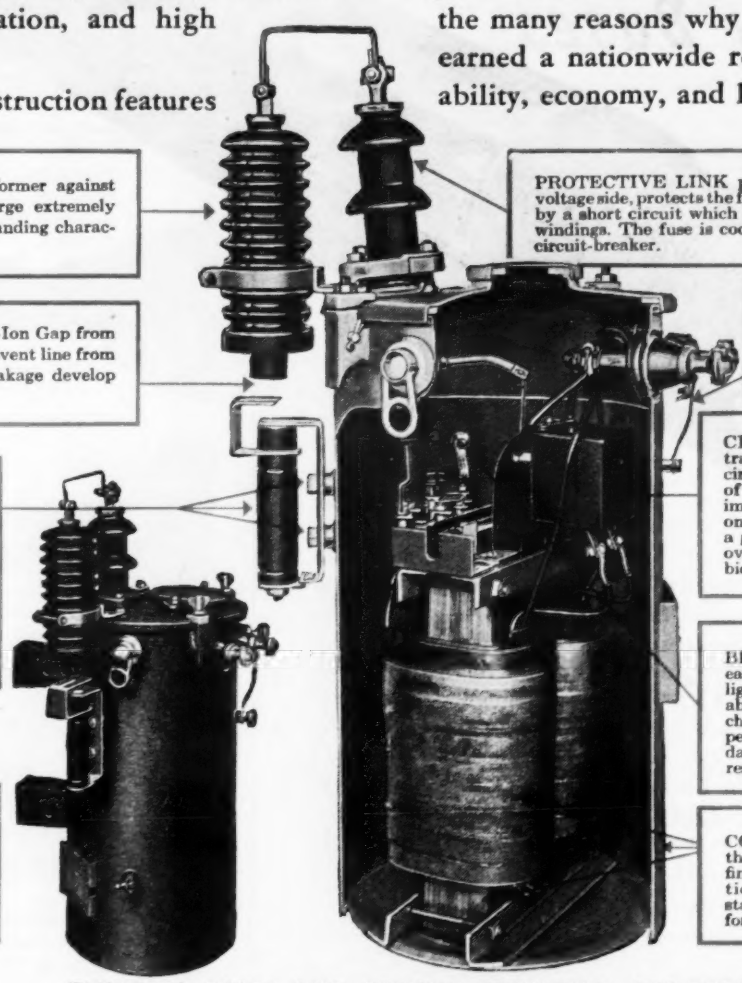
Many design and construction features contribute to the excellent reputation of Wagner Protected type transformers—too many to list in the space limitations of this advertising message. The features listed below are but a few of the many reasons why the type HEBF-P has earned a nationwide reputation for dependability, economy, and long life.

DE-ION GAP protects transformer against surges. The ability to discharge extremely high surge-currents is its outstanding characteristic.

ISOLATING GAP isolates De-Ion Gap from the ground series-resistor to prevent line from being grounded should any leakage develop in the De-Ion Gap.

SERIES-RESISTOR is furnished in order to limit the power-current (follow-current) which may flow after a surge has occurred. Double-mounting of the series-resistor assures correct location and spacing of the isolating gap.

Direct pole mounting brackets have standardized spacing for easy interchangeability. One or two mounting positions are available.



PROTECTIVE LINK placed in series with the high-voltage side, protects the feeder against line lockout caused by a short circuit which might occur in the transformer windings. The fuse is coordinated with the low-voltage circuit-breaker.

GROUND-STRAP grounds neutral low-voltage bushing externally to the tank. Tank is provided with solderless ground-connector.

CIRCUIT-BREAKER protects transformer from secondary short-circuits and over-loads. It consists of a switch thermally-operated—immediately in case of short circuit on the consumer circuit, and after a predetermined time interval for over-loads. Compensation for ambient temperature is automatic.

BREAKER RESET HANDLE is easily accessible. A warning signal-light, furnished on 5-kva sizes and above, serves as an automatic load check to give warning when temperature of windings reaches a dangerous level. It is built into the reset handle.

CORE AND COILS, as well as the TANK, embody the latest refinements in design and construction, and meet all recognized standards for distribution transformers.

THESE 29 SALES AND SERVICE BRANCHES ARE READY TO SERVE YOU

For complete information on Wagner Self-Protected Rural-Line Transformers (or other types of Wagner transformers such as distribution, power, air-cooled, substation, etc.) write to the address below or to the nearest of these 29 branches manned by trained field engineers who are ready to help you solve your transformer problems:

ATLANTA 3 • BALTIMORE 18 • BOSTON 15 • BUFFALO 8 • CHICAGO 16 • CINCINNATI 10
CLEVELAND 15 • DALLAS 1 • DENVER 2 • DETROIT 2 • HOUSTON 2 • INDIANAPOLIS 4
KANSAS CITY 8 • LOS ANGELES 15 • MEMPHIS 3 • MILWAUKEE 2 • MINNEAPOLIS 4
NEW YORK 7 • OMAHA 2 • PHILADELPHIA 8 • PITTSBURGH 13 • PORTLAND 9 • ST. LOUIS 3
SALT LAKE CITY 1 • SAN FRANCISCO 3 • SEATTLE 4 • SYRACUSE 2 • TULSA 3 • WASHINGTON 5

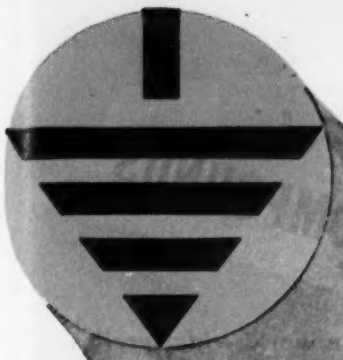
T45-8

TRANSFORMERS are but one of several WAGNER PRODUCTS serving industry.

Other WAGNER PRODUCTS:
AIR BRAKES
BRAKE LINING
HYDRAULIC BRAKES
INDUSTRIAL BRAKES
INDUSTRIAL BRAKE CONTROLS
TACHOGRAPH (Recording Speedometer)
ELECTRIC MOTORS

Wagner Electric Corporation
ESTABLISHED 1891
6456 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

At This Sign



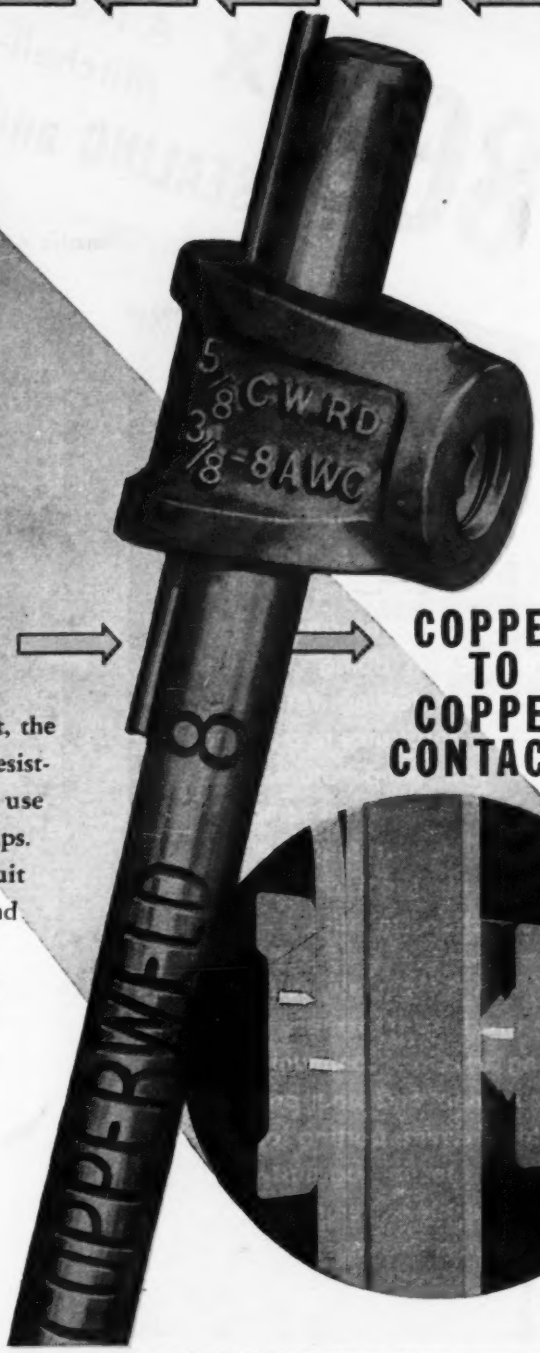
Copperweld

CONQUERS CORROSION

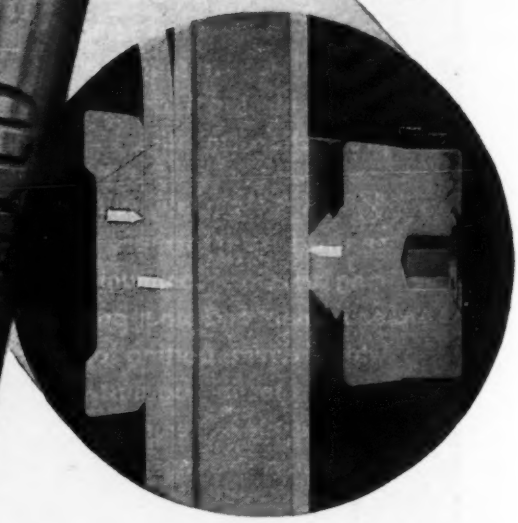
Because there are no dissimilar metals in contact, the possibility of corrosion is eliminated and high resistance connections cannot occur when you use Copperweld non-rusting Ground Rods and Clamps. And with them you provide an all-copper circuit from the top of the pole to the bottom of the ground rod.

They have other advantages, too. The stiff steel core makes the rod easy to drive. The rugged one-piece clamp body provides a simple, dependable connection. Copperweld's unique method of manufacture insures safe, trouble-free ground connections during a lifetime of service

MADE BY
COPPERWELD STEEL COMPANY
GLASSPORT, PA.



COPPER TO COPPER CONTACTS



Copperweld NON-RUSTING GROUND RODS AND CLAMPS

NATIONAL SALES AGENT:
HUBBARD AND COMPANY PITTSBURGH, PA.

M-R

#868 EX A New Star in Mitchell-Rand's Galaxy of SEALING and POTTING COMPOUNDS

Now in world-wide service, successfully withstanding the rigors of climatic extremes . . . from minus 40° F. to plus 180° F.

After two years in test #868 EX was made available to meet the most damaging conditions known for potting compounds. Its qualities soon became apparent and today #868 EX is doing 'Yeoman Service' protecting war equipment by resistance to cracking from low temperatures and flow from elevated temperatures while retaining the necessary electrical and waterproof characteristics.

868 EX is especially suited for sealing transformers, lightning arrestors, communication equipment and other products which require potting for positive protection against moisture despite extreme temperatures, plus or minus.

#868 EX has a high content of mineral filler.

. . . after being subjected to 180° F. for 8 hours showed very good resistance to cold flow.

. . . submitted to temperatures of minus 40-50° F. for several hours, did not fracture readily or show excessive brittleness. At 0° F. to 20° F. 868 EX showed remarkable flexibility.

. . . has good adhesion, toughness, resistance to fracture, waterproof and dielectric qualities.

PHYSICAL CHARACTERISTICS

Softening Point (ring and ball)		245° F.
Specific Gravity (60° F.)		2.02-2.03
Penetration of Basic Compound	32/200/60	26
	77/100/5	40
	115/50/5	55
Flash Point		475° F.
Fire Point		565° F.
Suggested Pouring Temperature		400° F.-425° F.

Upon written request a One Gallon Sample of #868 EX will be sent, gladly, for laboratory tests

MITCHELL-RAND for 56 YEARS THE ELECTRICAL INSULATION HEADQUARTERS EST. 1889

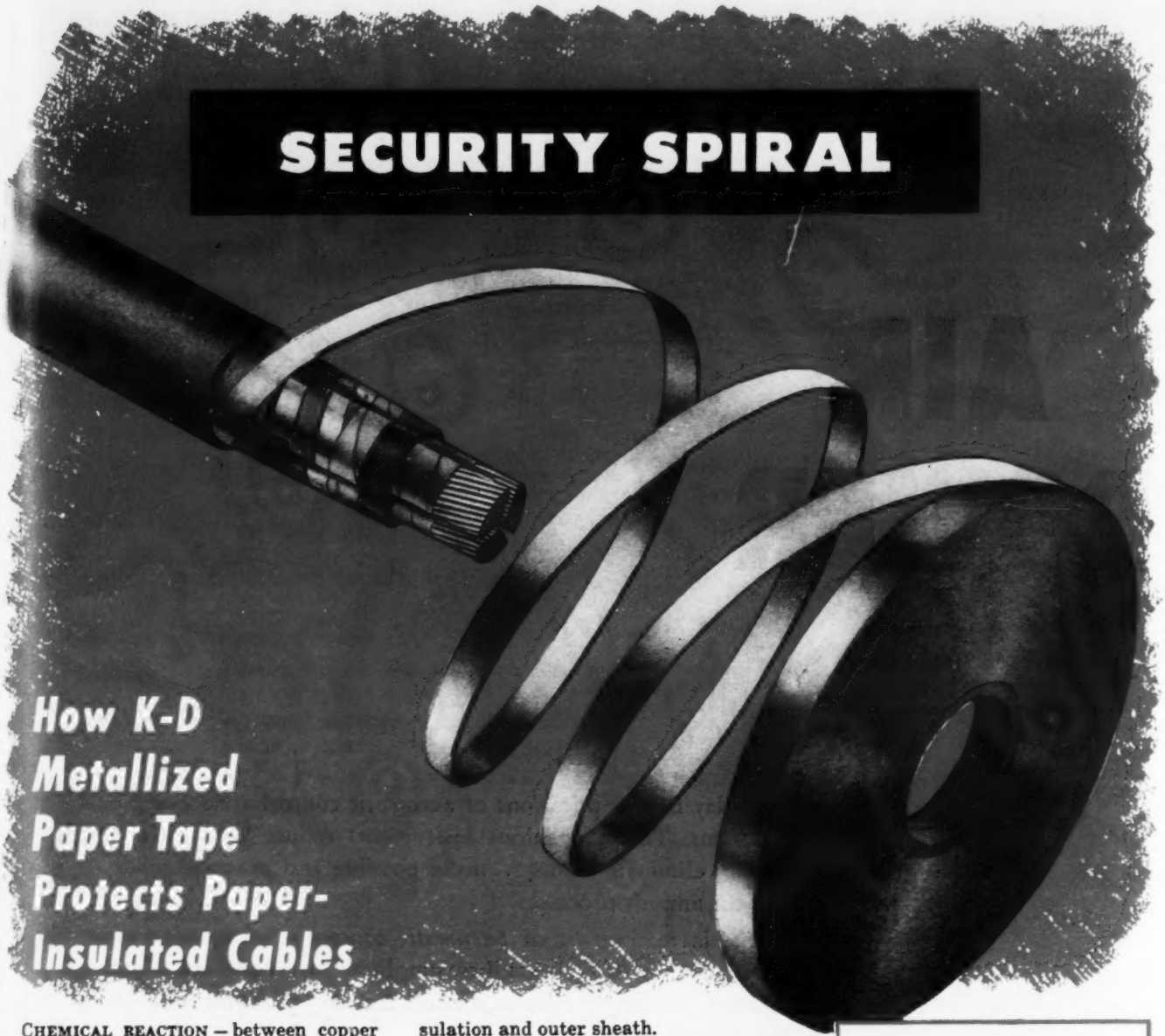
MITCHELL-RAND INSULATION COMPANY, INC.

51 MURRAY STREET COrtlandt 7-9264 NEW YORK 7, N.Y.

A PARTIAL LIST OF M-R PRODUCTS

Fiberglas Varnished Tape and Cloth
Insulating Papers and Twines
Cable Filling and Pothead Compounds
Friction Tape and Splice
Transformer Compounds
Fiberglas Saturated Sleeving and Varnished Tubing
Asbestos Sleeving and Tape
Varnished Cambric Cloth and Tape
Mica Plate, Tape, Paper, Cloth and Tubing
Fiberglas Braided Sleeving
Cotton Tapes, Webbings and Sleevings
Impregnated Varnish Tubing
Insulating Varnishes of all types
Extruded Plastic Tubing

SECURITY SPIRAL



How K-D Metallized Paper Tape Protects Paper-Insulated Cables

CHEMICAL REACTION – between copper conductor and impregnating oil in paper-insulated cables–can spell losses in power and profit to utilities. But with Keller-Dorian Metallized Paper Tape *wrapped over each conductor*, an effective barrier is set up between conductor and insulation. Besides . . .

A smooth base is provided for winding insulating tape . . . uniformity of electrical stress is obtained.

Corona – with its accompanying power leaks – is eliminated. That's because Keller-Dorian Metallized Paper Tape, *wrapped over the insulation*, acts as an electrostatic shield between insulation and outer sheath.

Excessive ionization is absent–which means lessened cable deterioration.

Thermal aging of the impregnated paper is retarded.

Lower power factor . . . higher dielectric strength . . . greater breakdown values . . . increased safety factor – these, too, you get.

To translate these performance advantages into added profit dollars, specify electrical wires and cables protected with Keller-Dorian Metallized Paper Tape . . . the security spiral. Keller-Dorian Corporation, Empire State Building, New York 1, N. Y.

Keller-Dorian Metallized Paper Tape is used in Wires and Cables Made by these outstanding manufacturers:

American Steel & Wire Co.

General Cable Corp.

General Electric Co.

Okonite-Callender Cable Co.

Simplex Wire & Cable Co.

U. S. Rubber Co.

KELLER-DORIAN

CORPORATION

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

METALLIZED PAPER TAPES FOR ELECTRICAL WIRES AND CABLES

AIR POWER

for Automatic Control

Each day new applications of automatic control are solving new problems. These ingenious instruments reduce time, save man power, eliminate errors . . . make possible and practical many of our continuous processes.

The increasing use of *pneumatic* control is recognition of its many advantages . . . reliability, simplicity, safety and ease of maintenance. In many processes it offers the only practical solution of the control problem.

Such service demands the best of air compressors. When oil-free air is a "must" Ingersoll-Rand Type N-L (non-lubricated) compressors should be installed. In these compressors the cylinders are designed to operate without oil, glycerine, water or other form of lubricant . . . because they have special pistons fitted with graphitic carbon wearing rings and piston rings. Sizes from 5 to 300 hp . . . pressures up to 125 psi.

FOR COMPRESSORS FOR ANY SERVICE
CONSULT INGERSOLL-RAND

Ingersoll-Rand

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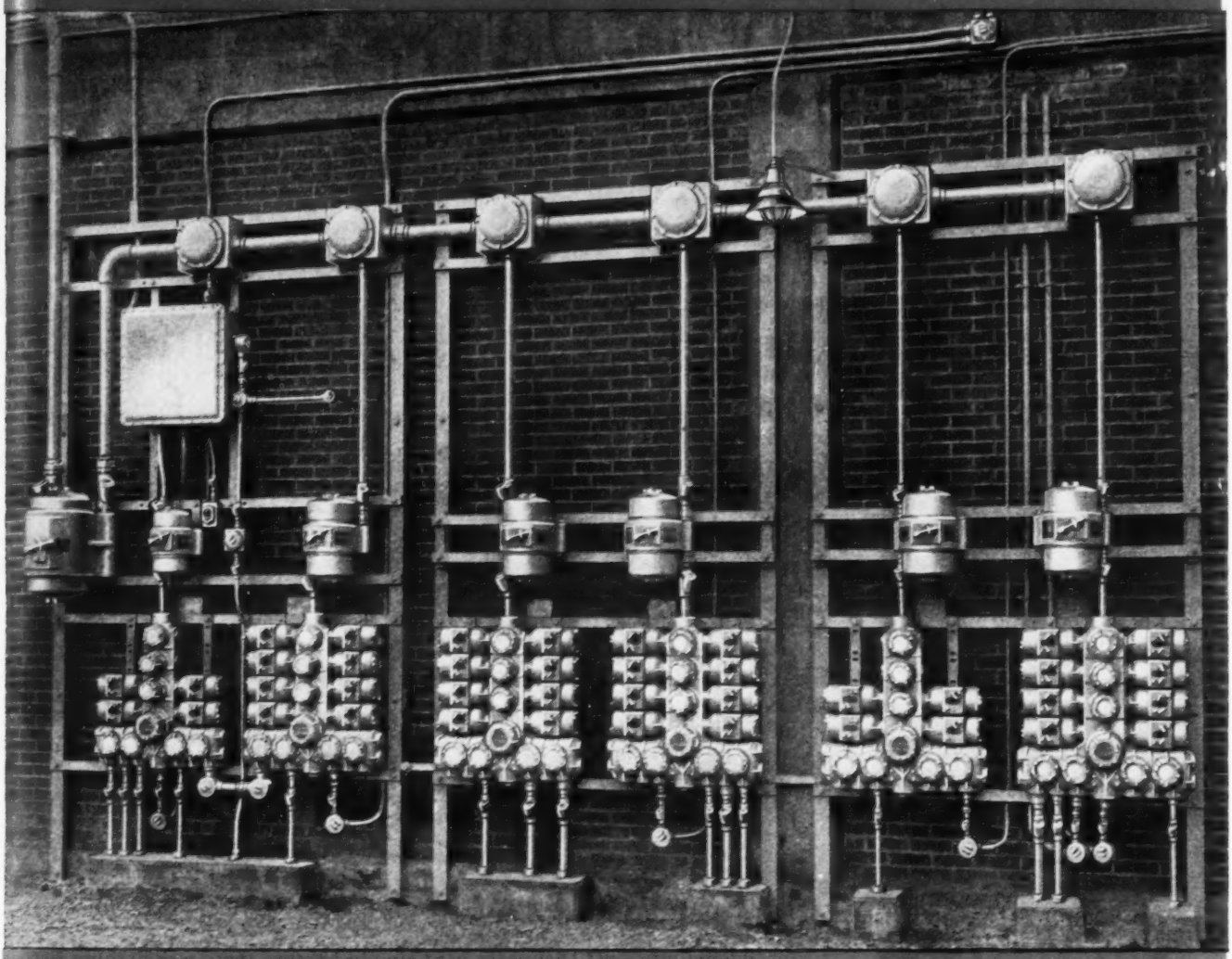
COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS
OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

CROUSE-HINDS



Explosion-Proof Distribution Center in a Refinery

Distribution centers made of Crouse-Hinds explosion-proof CONDULETS provide safety; and convenient distribution to branch electrical circuits for light and power. They are for use in locations that are hazardous because of the probability of the presence of flammable gases or vapors.

The distribution center shown above was engineered and constructed by Crouse-Hinds Company. It was built in sections for convenience in handling and ease of installation. Additional sections can be added as needed. There are six Crouse-Hinds explosion-proof Type EDP panelboards with eighty branch lighting circuits and provision for adding sixteen more circuits. Each panelboard is protected by a separate circuit breaker and there is a main circuit breaker for the feeder —— all housed in explosion-proof type EPC CONDULETS.

Crouse-Hinds Company's experienced engineering staff and complete manufacturing facilities are available for design and fabrication of lighting and power distribution centers, to meet field specifications. Equipment designed for all classes of hazardous locations, corrosive atmospheres, and exposure to the weather can be furnished.

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
SYRACUSE 1, N. Y., U.S.A.

Offices: Birmingham Boston Chicago Cincinnati Cleveland Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee Minneapolis New York Philadelphia Pittsburgh San Francisco Seattle St. Louis Washington. *Resident Product Engineers:* Albany Atlanta Charlotte New Orleans

CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

IF you're interested in today's efficiency... not yesterday's

read this ad

Even when kerosene lamps were employed widely, they were not considered efficient. They were used simply because there was nothing better.

On the same basis, many of the older types of circuit protection were considered adequate. But today, they are as out of place on circuits (in the 115, 220, 440 and 550-volt classes used in every plant) protecting valuable machines and important processes, as kerosene lamps would be where modern lighting now aids accurate seeing.

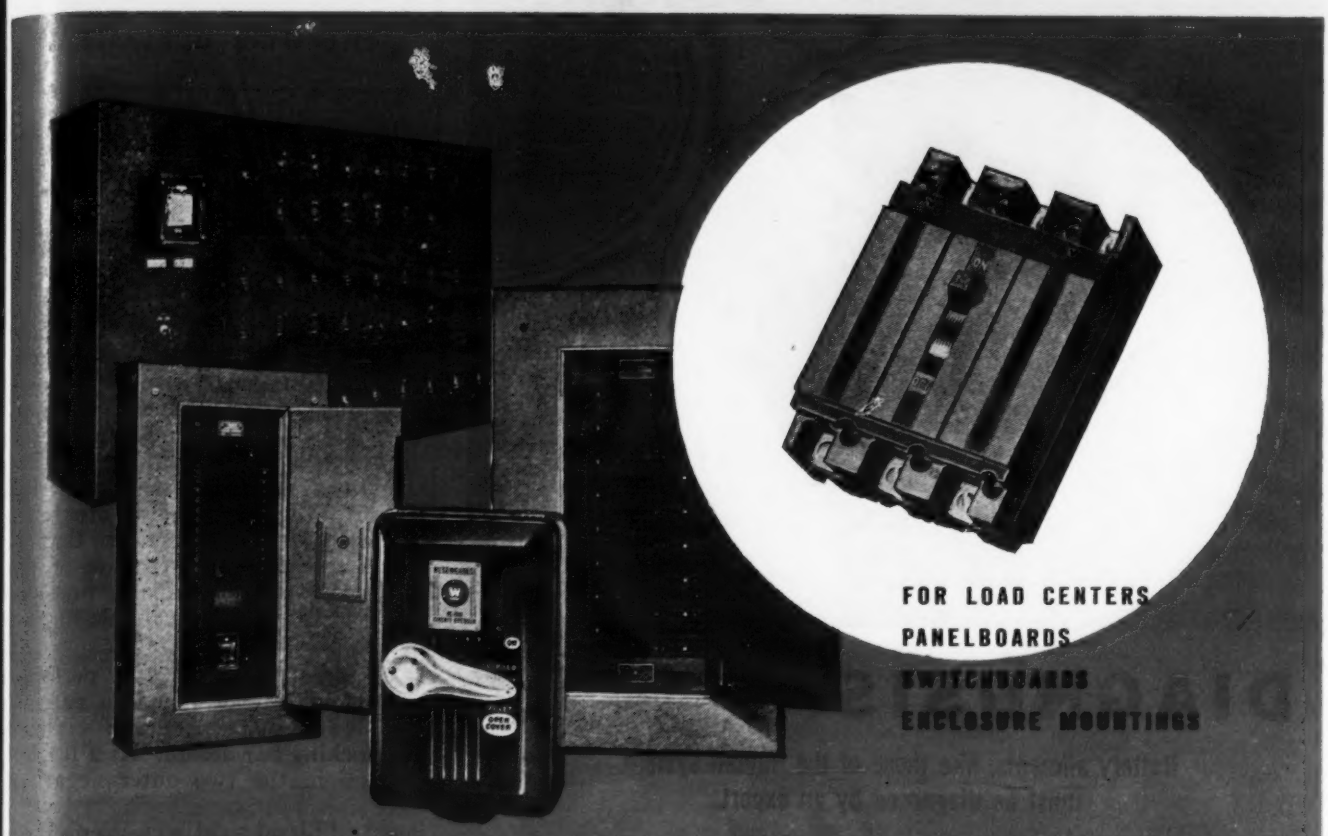
Modern circuit breaker protection is available today in every form required to protect essential industrial power, light and appliance circuits. Because the "De-ion" (fuseless) Circuit Breaker assures the best protection and the lowest lifetime cost of any protective device, progressive operating men and forward-looking business leaders are asking this question:

"Is it good business to continue to use 'kerosene-age' protective devices for 'air-age' plant equipment and circuits?"

The facts on the opposite page may help answer that question. J-60566

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE



there's only **ONE** efficient type of circuit protection by today's plant standards . . . .

"DE-ION" *(fuseless)* CIRCUIT BREAKERS

here's why...

1 **More positive protection for circuits and machines.** "De-ion" Breakers give accurately calibrated, *automatic* protection against severe overloads and short circuits . . . the same protection that safeguards vital equipment on our modern battleships.

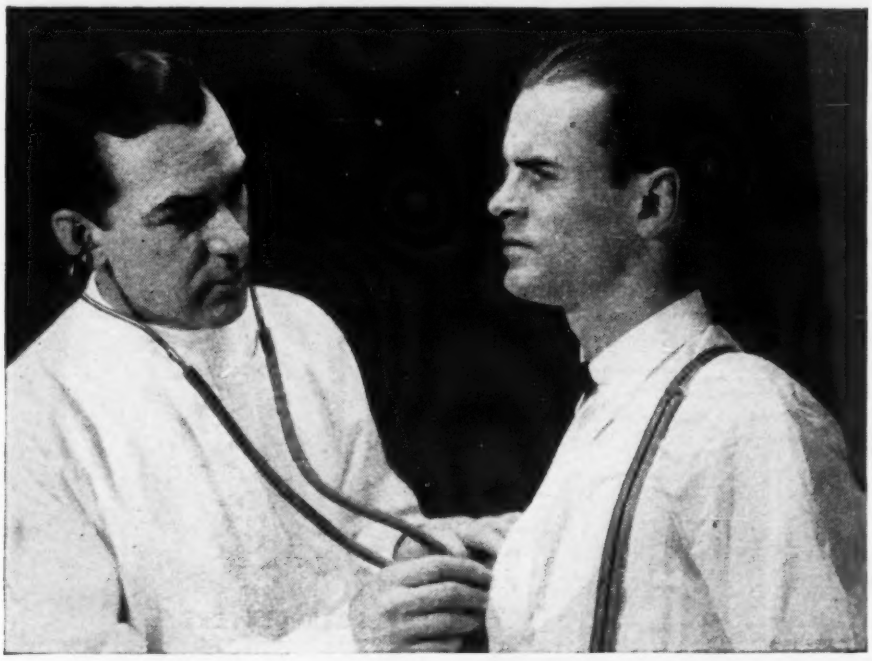
2 **Keeps machines on the job.** No unnecessary time out—"De-ion" Breakers do not interrupt production on harmless momentary overloads. When breaker does operate, service can be restored simply by closing the breaker. Nothing to replace or repair—no idle time lost waiting for special maintenance attention.

3 **Greater safety.** Completely molded insulated enclosures are positively sealed to protect workers and maintain calibration. Circuit breakers cannot be blocked with coins, nails, or other foreign articles.

4 **Lower costs**—"De-ion" (fuseless) Circuit Breakers have a lower lifetime cost. Nothing is destroyed or requires replacement when breaker operates.

Ask your Westinghouse representative for facts and figures. Westinghouse Electric & Mfg. Co., P. O. Box 868, Pittsburgh 30, Pa.

"DE-ION" *(fuseless)* CIRCUIT BREAKERS



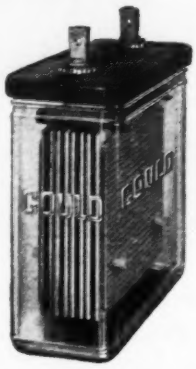
DIAGNOSIS

Battery ailments, like those of the human system, must be diagnosed by an expert.

Proper diagnosis of your battery requirements is the first step in obtaining efficient, economical battery service. Gould field engineers are technical experts. They can give you authoritative decisions on what type and size of battery is best for your particular job.

Behind these men is the Gould organization with half a century of battery research and experience. Originator of such outstanding batteries as the Gould Kathanode and the Gould Plante, the engineering department can be depended on to translate the field engineer's findings into the proper installation.

Here is a specialized service at your command. We invite you to use it.



Write Dept. 124 for Catalog 1000 on Gould Sealed-in-Glass Batteries for Stationary Applications.

GOULD

Since 1898 . . . THE BATTERY PICKED BY ENGINEERS

THE GOULD PLANTÉ

One of a series of informative articles for users of industrial batteries

In the Gould Plante construction you get a number of special features that have made this battery first choice for all stationary applications.

First of these is Gould's exclusive positive plate design. Made of one-piece pure lead, this plate is accurately ribbed to a predetermined cross-section depending upon the plate size. Then it is electro-chemically treated to coat both surfaces with a dense film of pure crystalline active material. This ribbing and forming create an unusually large active surface that remains constant over the life of the battery. Thus Gould Plante provides users with a battery capable of producing high discharge rates.

To match positive plate performance Gould has designed an antimonial-lead negative plate with an interlocking bar design. As a further protection, the two outer negatives have alternate narrow horizontal openings and broad solid sections on their external surfaces. This "barricaded" design of the outside negatives prevents over-expansion and loss of useful negative active material.

The far sides of each plate carry a hook that rests in a hard rubber channel, supported by plates of opposite polarity. This famous Gould "Dual Suspension" prevents misalignment or breakage of cell parts.

Assembled with separators of the highest quality Port Orford cedar, each element has horizontal lead projections cast as an integral part of the terminal posts. These rest on the top edges of the jar and, together with Dual Suspension, make unnecessary any bridge or tie-rod support.

Elements are centered and cushioned within the machine blown, annealed glass jars by soft rubber bumpers inserted in cylindrical openings in the outside negative plates.

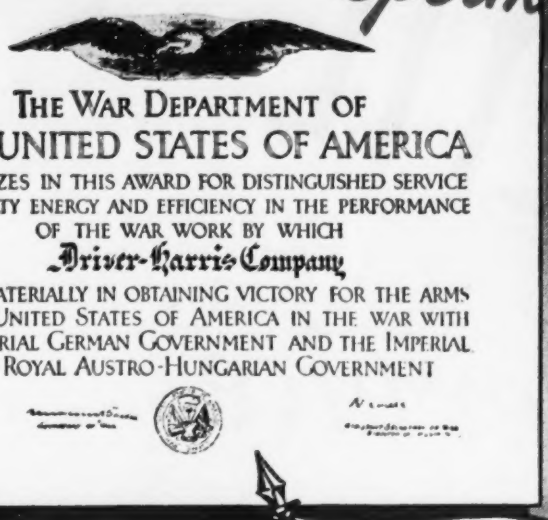
Covers are of hard rubber, with high mechanical strength. A new spool-type, soft rubber bushing assures an absolutely leak-proof seal around the terminal post projections.

This completeness of design, developed over half a century of battery research and experience, has resulted in a better product, better for the user from all standpoints.

For Excellence in storage battery production at Depew plant

GOULD STORAGE BATTERY CORPORATION, Depew, N. Y., Factories: Atlanta • Chicago • Dallas • Depew • Leavenworth • Los Angeles • North Bergen • Rock Island • St. Paul • Sioux City • Zanesville

Some Things speak for themselves



THE WAR DEPARTMENT OF
THE UNITED STATES OF AMERICA
RECOGNIZES IN THIS AWARD FOR DISTINGUISHED SERVICE
THE LOYALTY ENERGY AND EFFICIENCY IN THE PERFORMANCE
OF THE WAR WORK BY WHICH
Driver-Harris Company
AIDED MATERIALLY IN OBTAINING VICTORY FOR THE ARMS
OF THE UNITED STATES OF AMERICA IN THE WAR WITH
THE IMPERIAL GERMAN GOVERNMENT AND THE IMPERIAL
AND ROYAL AUSTRO-HUNGARIAN GOVERNMENT

1918

The parade of citations and stars awarded to Driver-Harris for contributions to the war effort in the highly specialized field of alloys, began as far back as 1918.

This equivalent of the Army-Navy "E" was awarded to our craftsmen 27 years ago in recognition for their "loyalty, energy and efficiency."

1945

4th CITATION

First exclusive manufacturer of electrical and heat-resistant alloys to receive the Army-Navy "E" Award for the 4th time. There is no greater reward for the steadfast devotion of Driver-Harris employees to their country in time of war.

Driver-Harris COMPANY

HARRISON, N. J.

Branches: Chicago • Detroit • Cleveland
Los Angeles • San Francisco • Seattle

Famous for *Nichrome
made only by

D/H
SPECIAL PURPOSE ALLOYS SINCE 1893

*Trade Mark Reg. U. S. Pat. Off.

PANELYTE*

is a service . . .

As Well As A Complete Line Of Thermosetting Plastics!

PANELYTE is more than a trade-name for a wide range of structural laminated resinous plastics. The mass-production of sheets, rods, tubes, molded forms and fabricated parts — research and engineering accomplishments . . . plus accumulated application knowledge—adds further significance to the name. The sum-total is expressed in PANELYTE Service . . . from coast-to-coast!

Come to PANELYTE for reliable, up-to-the-minute information on the use of thermosetting plastics. Ask us *if* and *how* laminated plastics can be employed to produce better structural and insulating parts for you — in less time — and at lower cost. PANELYTE engineers, familiar with properties, advantages *and* limitations, can recommend the specific grade best suited to a given application. Their design advice can prevent costly errors. Efficient, straight-line production assures adherence to specifications and prompt deliveries.

Avail yourself of PANELYTE Service by giving us detailed information on the design and use of the part in question.

Write for factual Data Book!

PANELYTE *the structural plastic*

PANELYTE DIVISION
ST. REGIS PAPER COMPANY
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NEW YORK 17, N. Y.

Sales Offices: Atlanta, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Los Angeles, Mexico City, Montreal, New Orleans, Phoenix, St. Louis, St. Paul, San Francisco, Seattle, Syracuse, Toronto, Trenton, Vancouver

* MASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS IN PAPER, FABRIC, FIBRE GLASS, WOOD VENEER AND ASBESTOS BASE LAMINATES

THIS SPRING FWDs ARE DOING

More Work WITH *Less Manpower*

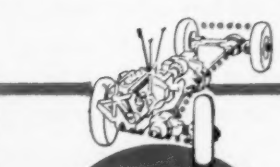
Embodied in this FWD Model SU is the accumulated experience of 35 years of four-wheel-drive leadership . . . a truck that has won extraordinary recognition and endorsement of motor truck users, in less than four years, to the extent of $75,000,000.00 in purchases.

The FWD Model SU Truck commands the attention of all who know quality. Superior power, ruggedness, speed and ability to perform without waste, are recognized FWD truck values that help overcome today's handicaps of manpower shortage.

FWDs are multiplying available manpower by increasing the range and capacity of trained crews. FWDs go anywhere . . . get crews and equipment to any operation, off the highway or on it, in any weather, over even the tougest terrain, all year 'round, on trouble-shooting emergencies or routine jobs. Figure less depreciation, more years, more jobs done faster with FWDs . . . less upkeep and operating costs . . . less tire-wear . . . more work per gallon of gas, with balanced power delivered to all four wheels!

FOR ESSENTIAL INDUSTRIES, a limited number of FWDs will be available this year. Phone, wire or write us, or see the nearest authorized FWD dealer.

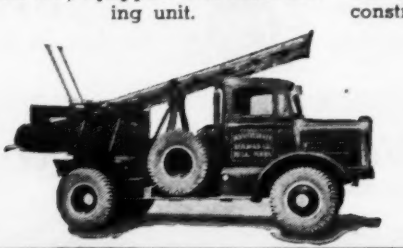
THE FOUR WHEEL DRIVE AUTO CO.
Clintonville, Wisconsin
Canadian Factory: KITCHENER, ONTARIO



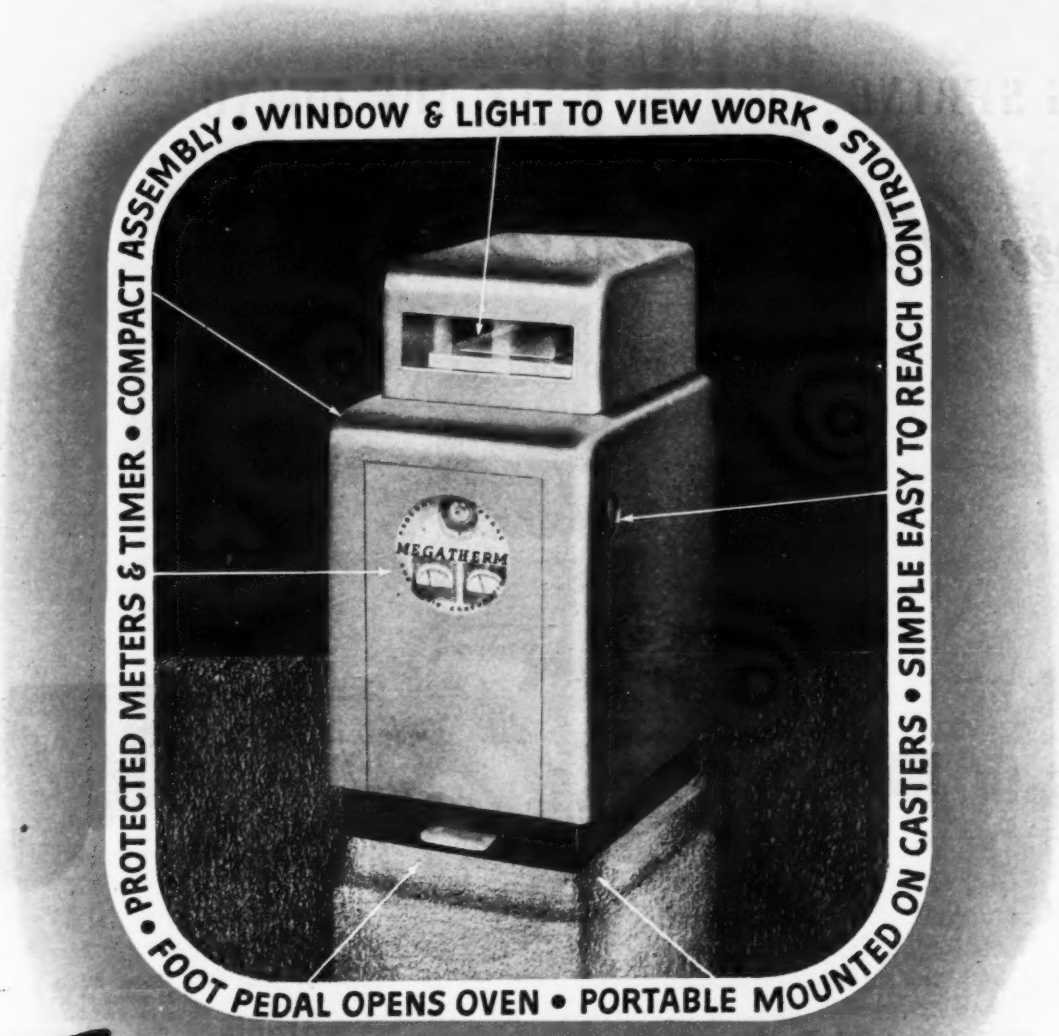
FWD TRUCKS

THE ORIGINAL EXCLUSIVE BUILDERS OF FOUR-WHEEL-DRIVE TRUCKS

Line construction and maintenance unit owned by Pennsylvania Railroad Co., equipped with earth-boring unit.



One of a fleet of FWD line trucks owned by New Jersey Bell Telephone Company — a unit that is without equal as efficient line construction and maintenance equipment.


• WINDOW & LIGHT TO VIEW WORK • SIGHTS
• COMPACT ASSEMBLY
• PROTECTED METERS & TIMER
• SIMPLE EASY TO REACH CONTROLS
• PORTABLE MOUNTED ON CASTERS
• FOOT PEDAL OPENS OVEN
MEGATHERM

Framed in Features

*NEW . . . THE 1 KW MEGATHERM**

Here is the Megatherm you have been waiting for . . . a compact dielectric heating unit designed for maximum performance.

Ideal for production line use in plastics processing . . . quick, uniform heating of plastic preforms permits free flow conditions in the mold . . . allows lowered closing pressures.

Fitting easily between molding presses, the new Megatherm is only 20 inches wide . . . mounted on smooth-running casters with a special lock down feature.

The Megatherm MD-1A is versatile . . . handles a wide range of materials and work sizes . . . heats plastics, rubber, rubber substitutes, wood, glue and other dielectrics . . . defrosts frozen foods, and shows great possibilities in the sterilization of pharmaceutical and similar products.

Write now on your company letterhead for data on the NEW 1 KW MEGATHERM.

FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

*Reg. U. S. Pat. Office

FOR EXCELLENT PROPERTIES IN ELECTRICAL APPLICATIONS CONSIDER...

POLYTHENE

A NEW PLASTIC MADE BY DU PONT

POLYTHENE, a versatile new plastic, possesses outstanding electrical properties. Its unique combination of good electrical and mechanical properties, in conjunction with unusual chemical resistance and ease of working, has accounted for its immediate acceptance in the field of electrical insulation, particularly for high-frequency systems. Its dielectric constant (at 60 cycles, 2.2-2.3) and power factor (at 10^6 cycles, <0.0005) remain constant over a wide range of frequencies, and the dielectric constant changes very little over the temperature range from -50°F to 220°F.

Because of polythene's extremely low moisture-absorption (less than 0.005%), its electrical properties are practically unaffected by changes in humidity. It is not affected by long immersion in brine. Standard electrical-grade polythene to which an inhibitor has been added shows only slight change in tensile strength or elongation after exposure outdoors for six months. Because polythene resists battery acids, and has good impact strength, application in this field will show many advantages.

Polythene was originated by Imperial Chemical Industries, Ltd., in Great Britain, and has been developed and improved by Du Pont.

AVAILABILITY. Du Pont is now producing polythene for important war purposes. However, quantities up to twenty-five pounds can be secured for experimental purposes according to WPB Order M-300, Schedule 60. Write for properties chart and other data to E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Arlington, N. J.

DU PONT

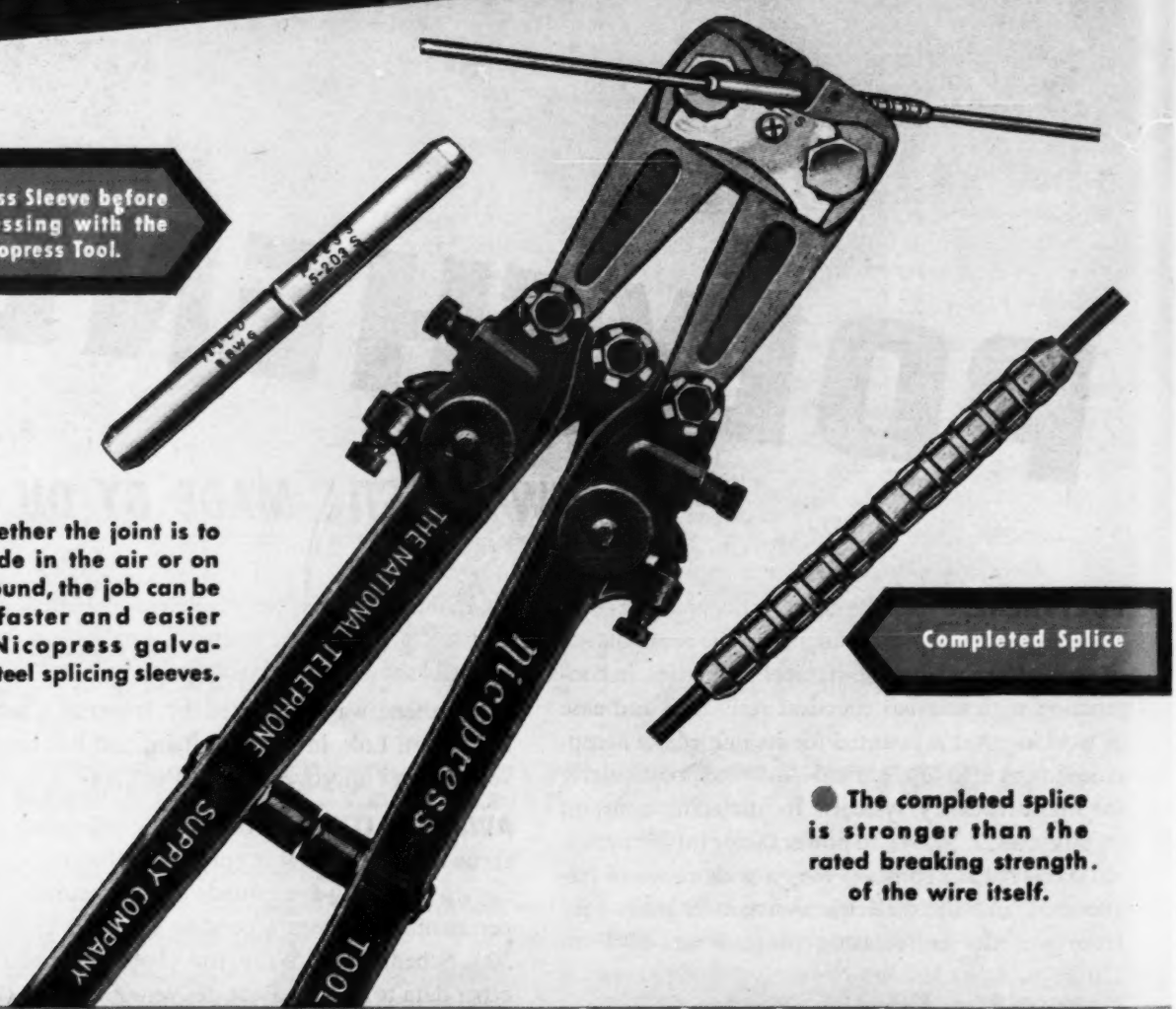
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

For Plastics—consult **DU PONT**

Yes! There's a special *Nicopress* Splicing Sleeve

for "80" and "130" High Tensile Steel Power Conductors!

Nicopress Sleeve before compressing with the Nicopress Tool.



Completed Splice

● Whether the joint is to be made in the air or on the ground, the job can be done faster and easier with Nicopress galvanized steel splicing sleeves.

● The completed splice is stronger than the rated breaking strength of the wire itself.

The National Telephone Supply Company

5100 SUPERIOR AVENUE • CLEVELAND 3, OHIO

Canadian Mfr.—N. SLATER CO., LTD., HAMILTON, ONT., CANADA

Export Distributor—INTERNATIONAL STANDARD ELECTRIC CORP., NEW YORK, N. Y.

THE NATIONAL TELEPHONE SUPPLY COMPANY

Kill tough fires before they grow—with Kidde equipment!

Kidde Kills Tough Fires

- GENERATORS
- MOTORS
- CONDENSERS
- CONVERTERS
- TRANSFORMERS
- SWITCHGEAR
- LIGHTNING ARRESTERS
- RECTIFIERS
- REGULATORS
- FLAMMABLE LIQUID STORAGE
- FILTER RECIRCULATION

• When fires break out in electrical equipment, the Kidde portable extinguisher or hose reel system acts fast to knock them down—and *out!*

Ordinary water-type extinguishers can't control these tough fires. But the Kidde portable shoots out a cloud of carbon dioxide gas that quickly penetrates through openings in housings, or mazes of wiring . . . to smother the flames.

The gas is non-conducting—no danger of shock to the operator. Safe for equipment, too—no water-soaking of apparatus or rotting of insulation. *And* no after-fire mess to be cleaned up.

Kidde equipment is equally fast, equally effective in extinguishing flammable liquid fires—leaves the liquids uncontaminated and undiluted.

Check the accompanying list of fire hazard areas in the public utility field. If any of them need protection in your power plant, call in a Kidde representative—you'll find him wise when it comes to fire protection. Drop us a line.

K Kidde

The word "Kidde" and the Kidde seal are trade-marks of Walter Kidde & Company, Inc.

Walter Kidde & Company, Inc. • 140 Cedar Street, New York 6, N. Y.

DOW CORNING

SILICONES

DOW CORNING, first in silicones, is fully equipped with new plant and facilities for the production and distribution of an expanding line of silicone products

American industry has been quick to utilize the new Dow Corning Silicones—to see the potentialities inherent in their higher order of heat stability, chemical inertness, water resistance, and dielectric properties. Dow Corning is now supplying, directly or through selected distributors, the following silicone products:

FLUIDS Water-white, odorless, inert Silicone Liquids . . . notable for their low rate of viscosity change over a wide temperature range, low vapor pressure, water repellency, and good dielectric properties.

4 Ignition Sealing Compound . . . an easily applied silicone waterproofing compound having excellent dielectric properties, corona resistance, and the consistency of petroleum jelly. It neither hardens nor melts at temperatures ranging from −40° F. to 400° F.

7 Special Low Temperature Compound . . . an oxidation resistant lubricant and sealing compound developed for use at temperatures as low as −70° F.

31 A lubricating Silicone Grease for special applications in the temperature range of −70° F. to 190° F.

41 A lubricating Silicone Grease for special applications where operating temperatures range from 0° F. to 400° F.

993 Insulating Varnish . . . recommended because of its extreme heat stability for impregnating, coating and bonding, and waterproofing inorganic insulating materials such as asbestos, mica, and Fiberglas cloth, tape, and sleeving. Other special purpose silicone resins and compounds are available.

STOPCOCK GREASE A chemically resistant Silicone Grease for lubricating stopcocks and other ground glass joints.

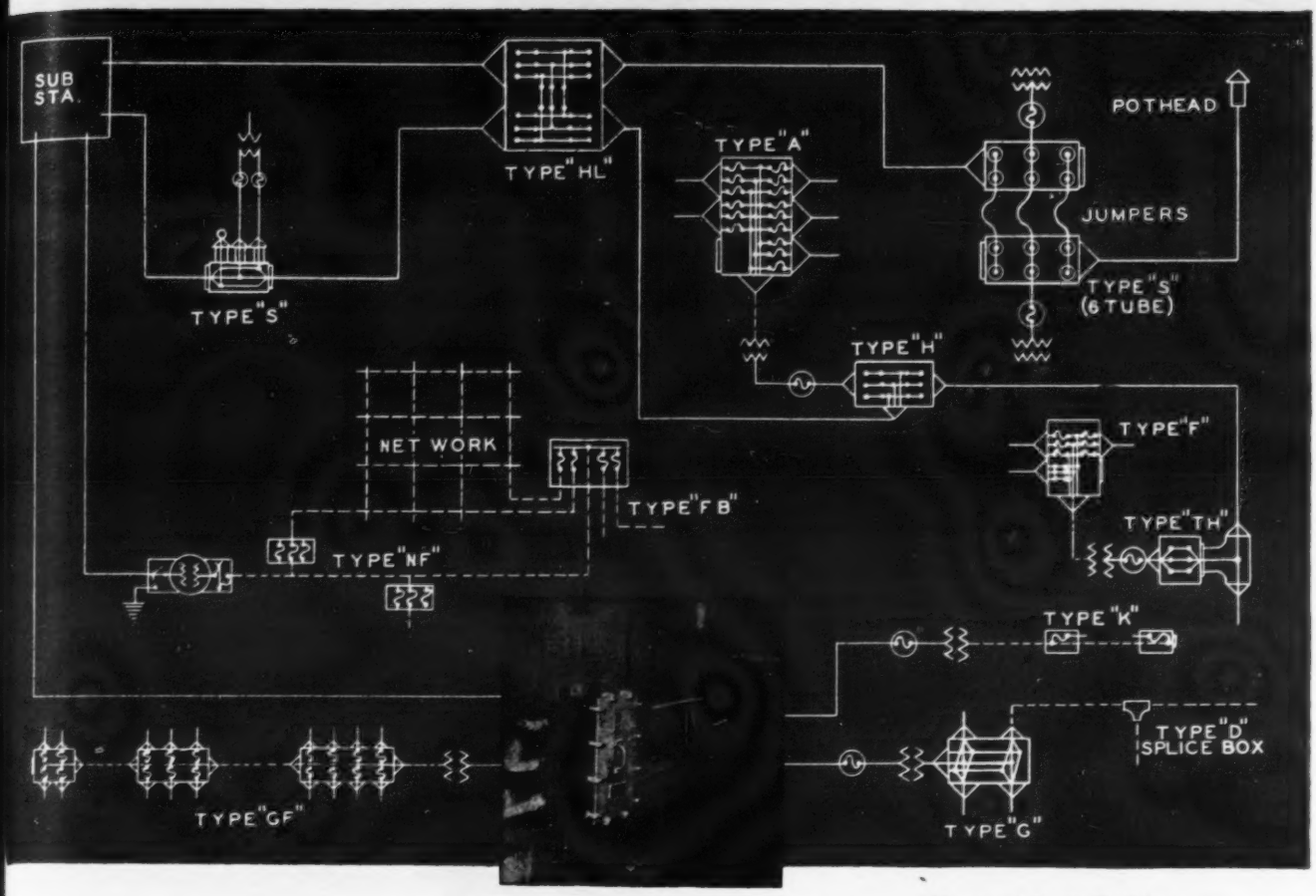
PLUG COCK GREASE A Silicone Grease that affords easy operation of lubricated plug valves over wide temperature ranges in most difficult services.

Dow Corning

FIRST IN SILICONES

DOW CORNING CORPORATION
MIDLAND, MICHIGAN
ADDRESS ALL INQUIRIES TO BOX 592

IN YOUR POSTWAR PLANNING *consider* G & W BOXES



Typical Installations

WATERTIGHTNESS INSURED

FACTORY TESTS—Boxes are filled with 5 to 15 lb. air pressure and submerged in a tank of water to make sure of NON-POROUS CASTINGS, sound welds and tight joints.

FIELD TESTS—After installation and after each time a box has been opened — make an air pressure test to insure that GASKETED JOINTS are tight. Use a tire pump and hold 5 lb. pressure for 15 minutes.

Underground cable boxes are an important item in an electrical distribution system. They establish the desirable control over the duration and the extent of service interruptions. The ideal system is one which provides maximum service continuity of service at minimum overall cost. The increased use of electric light and power makes it extremely difficult to arrange for even brief outages for necessary system changes and additions. Sectionalizing boxes permit circuit detours without dropping important loads. Fuse boxes minimize the extent of cable trouble. Distribution boxes provide for proper system maintenance with the least service interruptions.

G & W is always ready and willing to cooperate with you in designing and furnishing either cast or welded watertight boxes to meet your particular requirements.

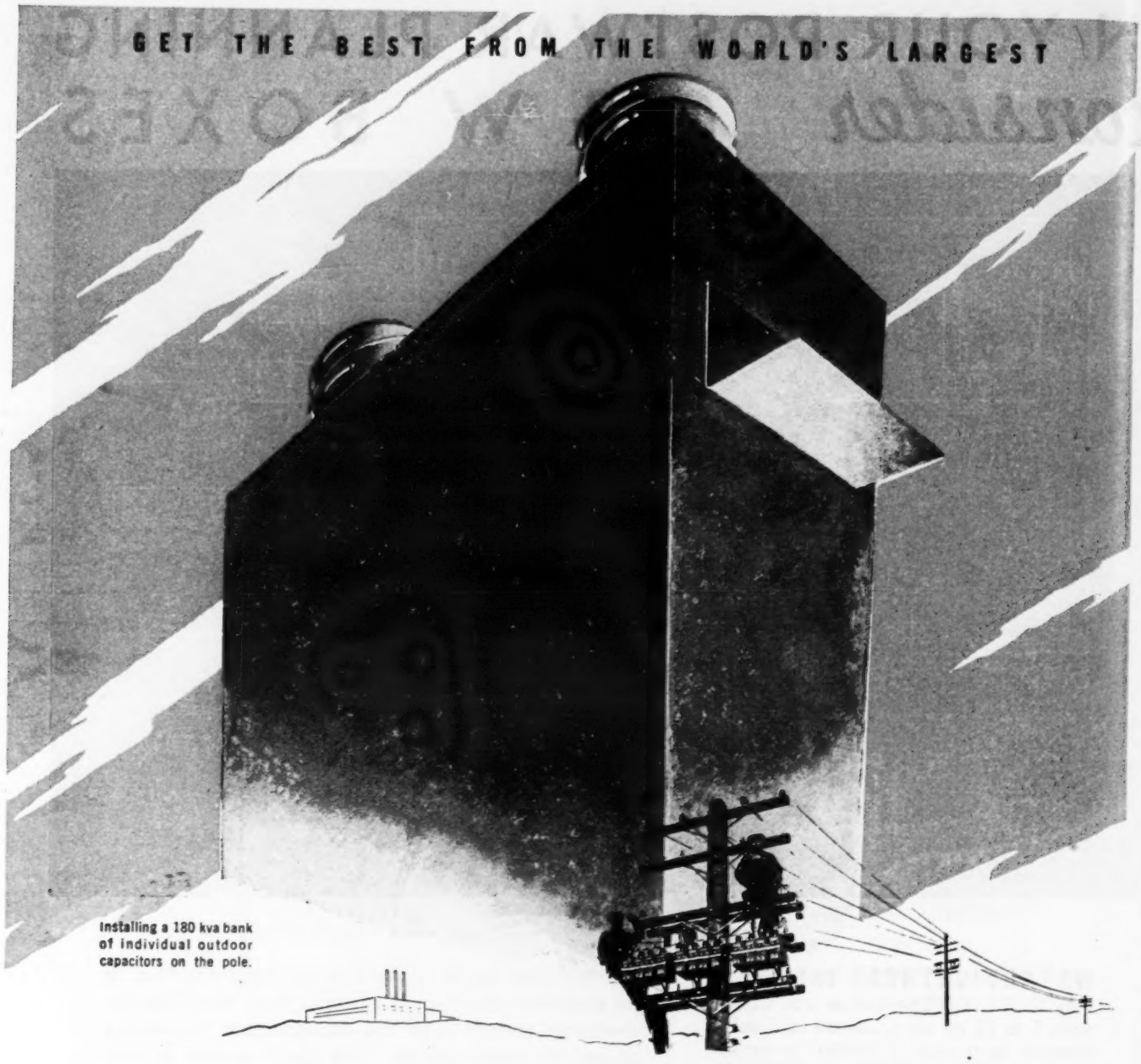
Send for Bulletin No. 403

G&W ELECTRIC SPECIALTY CO.
Dependable Cable Accessories

7780 DANTE AVE., CHICAGO 19, ILL.

Also made in Canada by Powerlite Devices, Ltd., Toronto

GET THE BEST FROM THE WORLD'S LARGEST



Installing a 180 kva bank of individual outdoor capacitors on the pole.

MORE LOAD CURRENT on your present lines with C-D capacitors

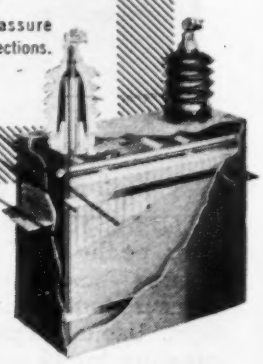
Easy to install and easy to re-locate when loads change, C-D Capacitors enable you to gain capacity anywhere on your system quickly and inexpensively without adding new feeders or substation equipment.

Electric service companies everywhere are installing C-D Capacitors as a low-cost means of gaining needed capacity. A typical application is this substation installation of 15KVA, 2400 volt individual C-D Capacitor units.

Look into the advantages of C-D Capacitors for your system. Your local C-D field engineers will be glad to give you full information. Write today to Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

3 typical Cornell-Dubilier extra quality features

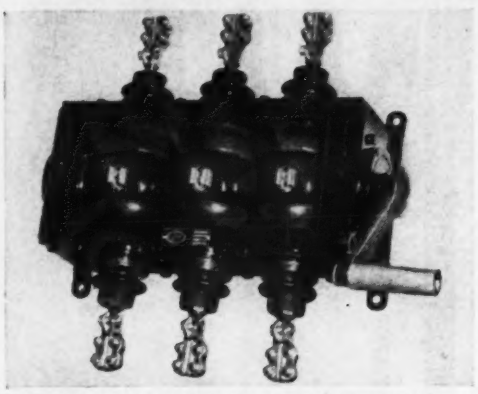
1. Stacking of sections is uniform.
2. Sturdy steel tension bands equalize pressure throughout capacitor.
3. Compact rigid end plates assure uniform pressure on stacked sections.



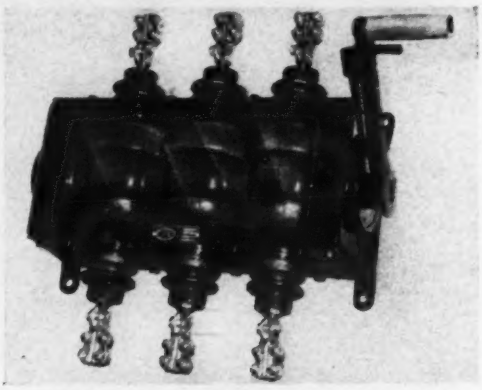
CORNELL-DUBILIER CAPACITORS

SAFETY SWITCH

ENCLOSED IN GLASS SO YOU CAN SEE THE SWITCH POSITION!



"YOU SEE WHEN IT'S OPEN"



"YOU SEE WHEN IT'S CLOSED"

ELPECO'S ROTA SAFETY SWITCH

With the ever increasing tendency for higher voltages in indoor installations, ELPECO has developed the Rota Safety Switch to meet the conditions encountered in Utility Companies and other industries.

Elpeco's Safety Switch has a front and back panel of glass, which offers many essential advantages. It provides a visual indication of switch position . . . prevents the operator from coming in contact with live parts . . . allows safe distance from the live parts to the ground.

In the design and development of this switch, every consideration was given to the class of service to which it would be applied, and it is particularly well adapted for inspection and repairs. **It is furnished with single or double terminator for cable-type connections.**

We invite inquiries for installations requiring this type of switchgear. Write us today.

Features:

1 Dustproof.

2 Minimum space required.

3 Hand or electric operation.

4 Can be operated direct or remote control.

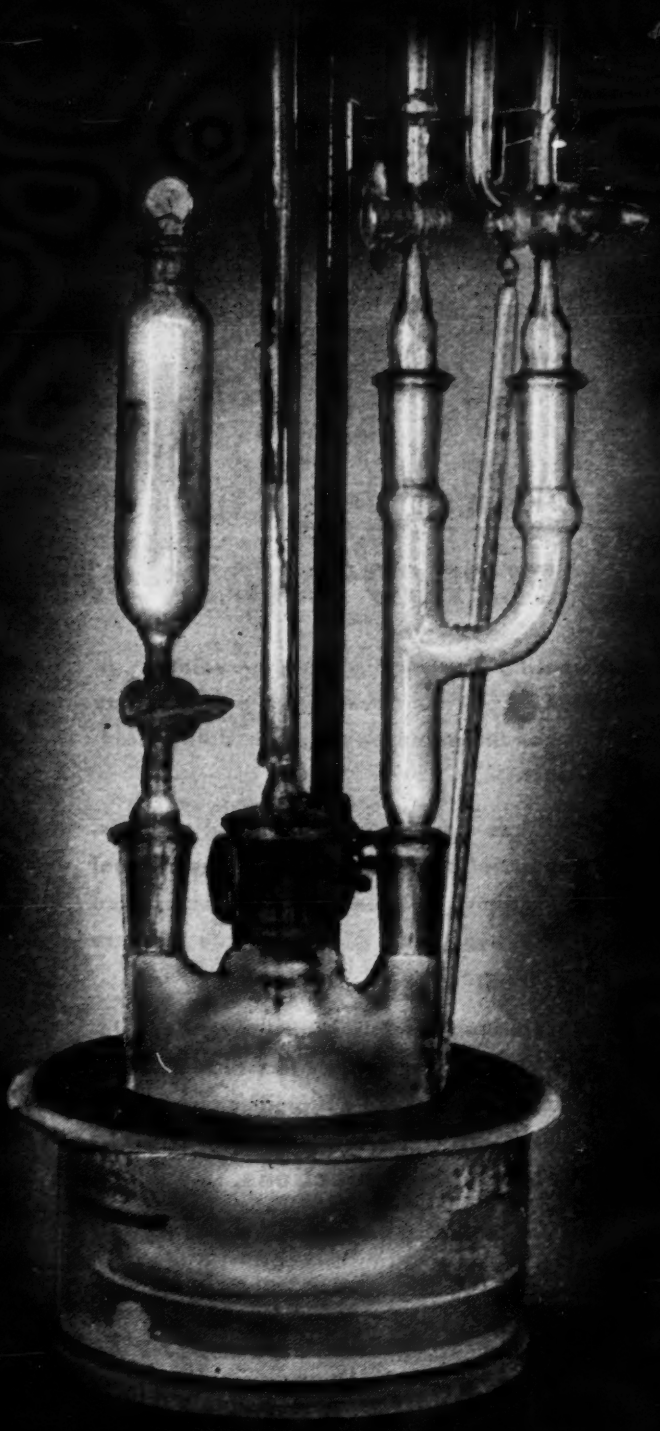
5 Being fully enclosed, there are no live parts exposed in either open or closed position.

6 Easily mounted.

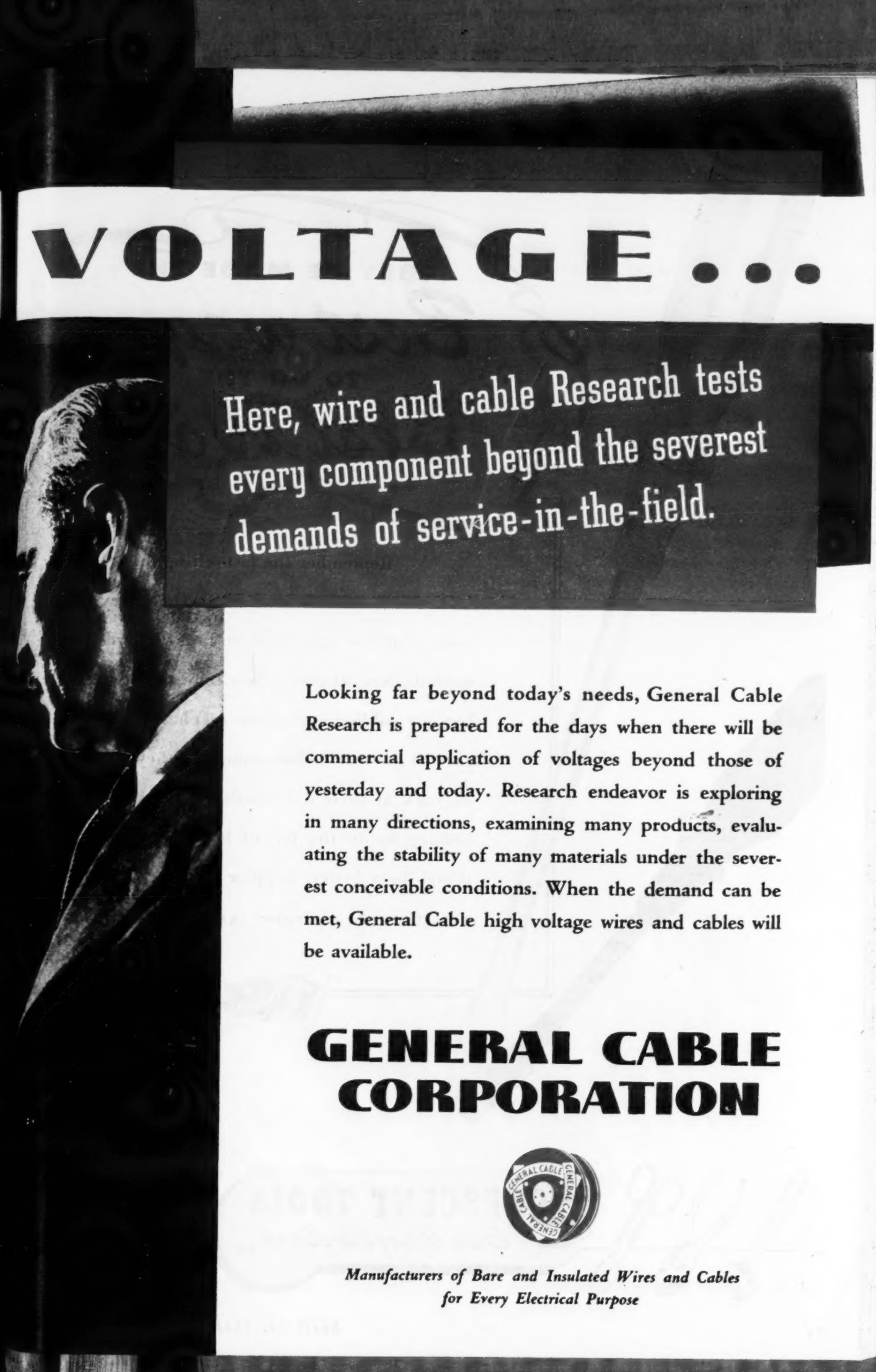
FOR 29 YEARS MANUFACTURERS OF SWITCHGEAR AND DEVICES

ELECTRIC POWER EQUIPMENT CORPORATION
412 NORTH 18TH STREET, PHILADELPHIA 30, PA.

TO RESIST



Electronic bombardment of high voltage cable oil under vacuum at 10,000 volts, a test as unique as it is purposeful, is but one indication of the searching investigations here undertaken.



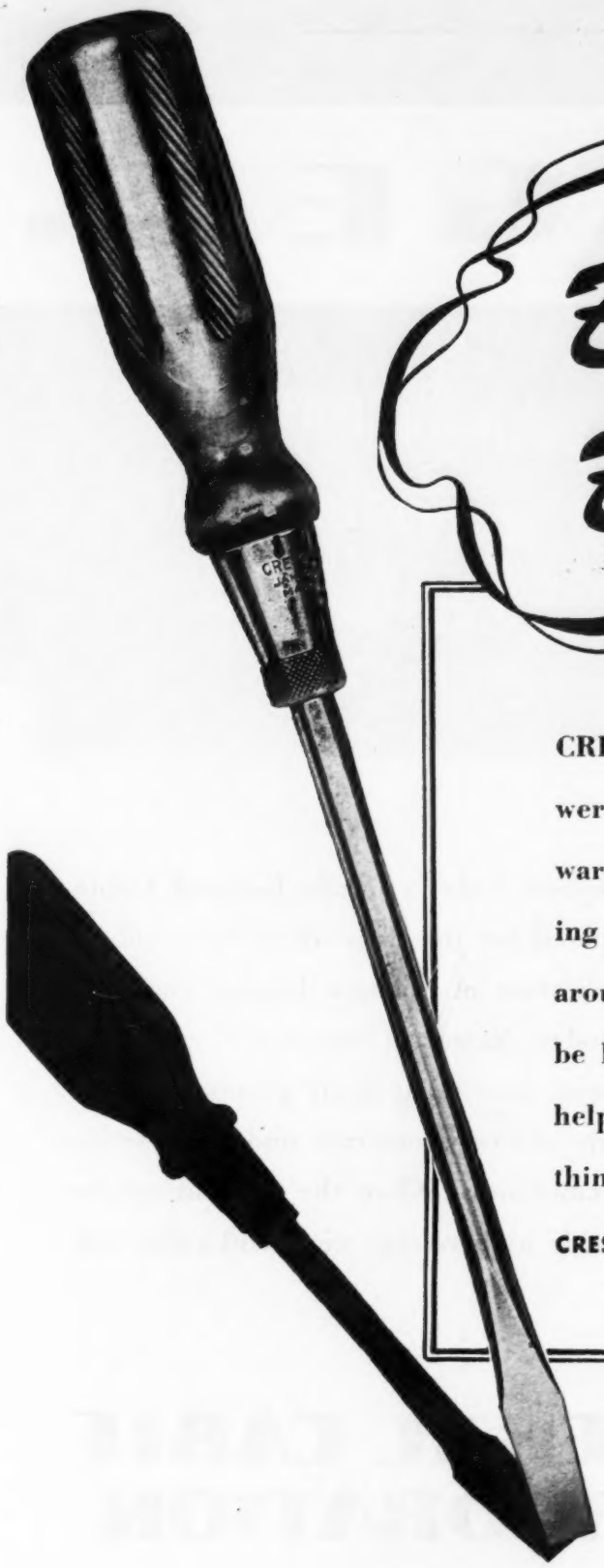
VOLTAGE . . .

Here, wire and cable Research tests every component beyond the severest demands of service-in-the-field.

Looking far beyond today's needs, General Cable Research is prepared for the days when there will be commercial application of voltages beyond those of yesterday and today. Research endeavor is exploring in many directions, examining many products, evaluating the stability of many materials under the severest conceivable conditions. When the demand can be met, General Cable high voltage wires and cables will be available.

GENERAL CABLE CORPORATION

Manufacturers of Bare and Insulated Wires and Cables for Every Electrical Purpose

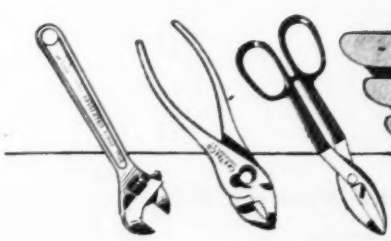


THEY'RE MADE THE *Best way...* TO DO THE *Best Work*

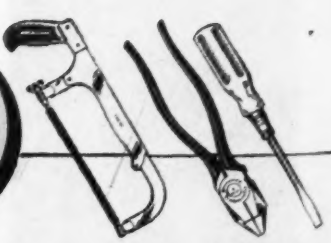
Remember the fast-selling line of CRESCENT SCREWDRIVERS? Once they were a familiar sight on thousands of Hardware dealers' displays. Now they are helping our soldier and sailor mechanics all around the world. But some day, they will be back at their old familiar haunts . . . helping to do the job of building better things in a better, happier world.

CRESCENT TOOL COMPANY, JAMESTOWN, N.Y.

ARMY E NAVY



CRESCENT TOOLS
Give Wings to Work



No matter how tiny the coil

LUMARITH* C.A.

Keeps the Black Hand of Corrosion at bay

MANY TYPES of insulation, in the presence of moisture and current, create free acids highly corrosive to current-carrying copper wire. In such instances this electrolytic action is a *built-in* hazard.

Lumarith C.A. (cellulose acetate base) is chemically inert in electrical applications. It does not give rise to corrosion even on fine copper wire.

Many fabricators use tubing of spiral wound Lumarith C.A. film to make exceptionally strong cores. They are offered by various manufacturers in round, square and oval shapes. Other Lumarith C.A. films are available in plain or in special mat finish (A78) for easier winding. Slippage is reduced, visibility increased.

Lumarith C.A. is also supplied in thin foil for coil linings, coverings and interlayer insulation, and in molding materials for coil spools, bobbins, housings, bases and plugs. Send for the Lumarith Electrical Booklet. Celanese Plastics Corporation, a division of Celanese Corporation of America, 180 Madison Avenue, New York 16, N.Y.

A Celanese Plastic*

*Reg. U. S. Pat. Off.

ON THE JOB . . . WITH KLEINS

● Extension of communication lines and power lines—the improvements in existing services—are waiting for the men and materials now so vital to complete victory. When that time comes, Kleinmen will be back on the job doing their part to aid the rapid transition from a war to a peacetime economy.

Serving these men will be the sturdy, reliable equipment carrying the name Klein so familiar to linemen and electricians since the first wires were strung nearly a century ago.

Today, Mathias Klein & Sons are producing the equipment they have always made—only more of it. This production will be available to serve peacetime industry as soon as the removal of war restrictions permits.

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York

This book on the care and safe use of tools will be sent on request.

Since 1857

Mathias KLEIN & Sons

Established 1857 — Chicago, Ill., U.S.A.

3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

BAKELITE

TRADE-MARK

LOW-LOSS—DESPITE HEAT AND HUMIDITY

BM-16981 is a new phenolic, mica-filled molding material with extraordinary low-loss characteristics under hot, humid conditions. BM-16981, indeed, retains its superior insulation qualities after long periods of immersion—greatly surpassing in this important respect all other mica-filled phenolics tested by the Bakelite Laboratories.

With its extreme resistance to water absorption, its excellent dielectric properties, and good molding qualities, BM-16981 brings you the opportunity to improve the performance of molded parts in applications subjected to heat and high humidity.

Specify BAKELITE molding material BM-16981 for completely new measures of service where atmospheric conditions are generally unfavorable for electrical insulation. Department 47 will be glad to send you detailed information upon request.

TRADE MARK

BAKELITE CORPORATION
Unit of
Union Carbide and Carbon Corporation

UCC

30 EAST 42ND STREET, NEW YORK 17, N.Y.

Molding Plastics

The BETTER

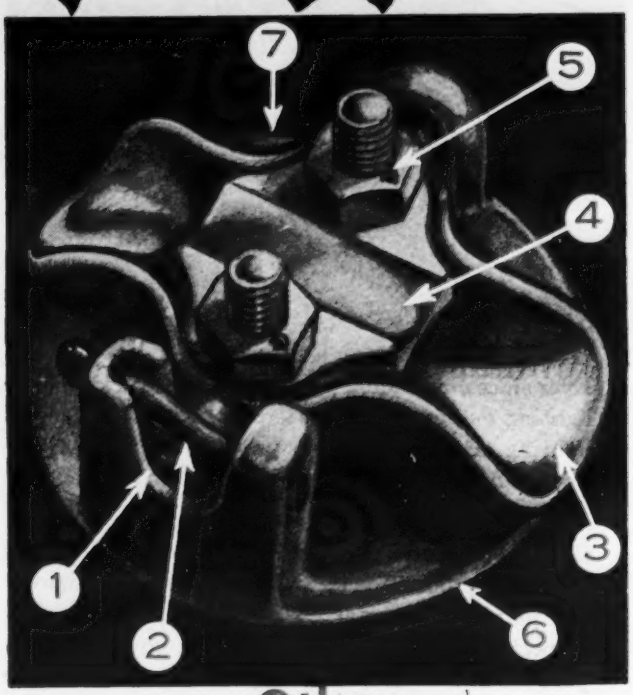
ORIGINATOR AND LARGEST MANUFACTURER OF WET-PROCESS PORCELAIN INSULATORS

LOCKE INSULATOR

FIRST IN CLAYRAMICS

Locke Clamp-Types

GIVE YOU THESE EXCLUSIVE ADVANTAGES



Eliminate Radio Interference

permanently. All metal parts are in initimate electrical contact at all times and under all conditions.

Conductors Are Protected

against burning. The heavy clamp mounting definitely keeps power arcs away from the easily damaged conductor.

No Loose Parts To Handle

in the air. The insulator minus the clamp is installed just as you would install any other pin type insulator. The clamp is attached loosely to the conductor on the ground. It is only necessary when installing the conductor to slide the clamp into its proper location, drop it into the mounting, drive home the cotter key and tighten the bolts.

No Special Tools

are required either to install or replace an insulator. Hot line maintenance is simple and fast using nothing but standard tools.

Other Valuable Features . . . .

1. High trunnion seat to permit maximum free clamp movement.
2. Heavy duty cotter key maintains electrical contact with the trunnion at all times. It cannot be completely removed, but is easily withdrawn to permit removal of clamp.
3. Wide, smooth bell mouth to eliminate conductor chafing.
4. Reversible keeper to accommodate maximum number of conductor sizes. Holds the conductor gently and firmly without danger of crystallization.
5. Special lock-nuts to prevent loosening of grip in service.
6. Overlapping cap protects cement joint from action of weather.
7. Smooth rounded edges to retard corona formation.

Only LOCKE clamp-types give you all these advantages

For nominal ratings from 34.5 KV to 69 KV, these better, time-saving units are available in either standard multipart or Hi-Top type.

Before you decide on the insulators for your next construction job, be sure to get all the details on Locke Clamp-Types.

FIFTY PROGRESSIVE YEARS OF SERVICE TO THE ELECTRICAL INDUSTRY

CORPORATION BALTIMORE MARYLAND

FIRST IN CLAYRAMICS

Whatever the lighting problem

SOLA makes the correct

TRANSFORMER

Ever since our defense program began to take shape, lighting engineers have been called upon to make lighting recommendations and installations that might have seemed impractical a short time before.

In every instance these lighting engineers solved the problems and eliminated bottlenecks that were hindering production of war materials. They lighted war plants covering acres of ground, solved critical inspection problems and installed equipment to produce illumination levels equal to those outdoors.

These and thousands of other lighting problems required serious thought and sound engineering. The possibilities of incandescent, mercury vapor or fluorescent lamps had to be explored. But regardless of the decision, regardless of the source used, the lighting engineer assured quiet, troublefree operation by specifying SOLA Lighting Transformers.

Tomorrow the lighting engineer and his customers will benefit by many important improvements in design and performance that will be made available when restrictions are lifted.

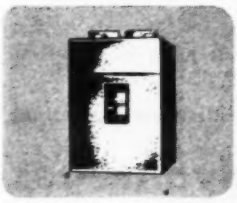
MERCURY VAPOR LIGHTING: High intensity mercury vapor lamps have been and will be used in many industrial plants where high bay mounting is essential. Ask for Bulletin 28 MV-76

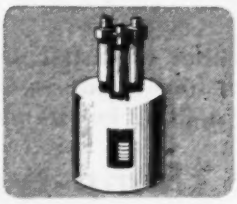
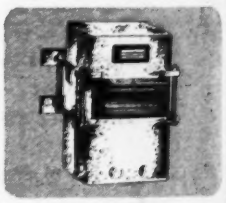
FLUORESCENT LIGHTING: SOLA ballasts still rate top preference with important fixture manufacturers. Ask for Bulletin 28 FL-86

COLD CATHODE LIGHTING: SOLA transformers incorporating the famous Constant Voltage principle are now available for operation of the long, slim cold cathode lamps. Ask for Bulletin 28 CC-104

SERIES LIGHTING: For airport, protective and street lighting or wherever the power supply must be sealed against dirt, dust or moisture, SOLA's new Series Transformer is without comparison. Ask for Bulletin 28 SS-97

POWER DISTRIBUTION transformers of the conventional double wound auto types, either step up or step down, can be used economically in providing the proper supply for lighting installations. Ask for Bulletin 28 DW-101



MERCURY VAPOR • FLUORESCENT • COLD CATHODE • SERIES LIGHTING • DISTRIBUTION

SOLA Lighting Transformers

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells and Chimes • etc. **SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago 14, Ill.**

. . . regardless of soil condition, Hoosier service assures the most efficient and economical method of handling every transmission line erection or maintenance job. Today this organization of trained men and special equipment is available to supplement your own organization in maintaining adequate service.

HOOSIER ENGINEERING CO.

46 S. FIFTH ST. COLUMBUS, OHIO
NEW YORK • CHICAGO

ERECTION AND MAINTENANCE OF TRANSMISSION LINES

YOU'LL WANT THESE ADVANTAGES OF

LIMITORQUE CONTROLS

IN YOUR PLANS FOR THE FUTURE . . . .

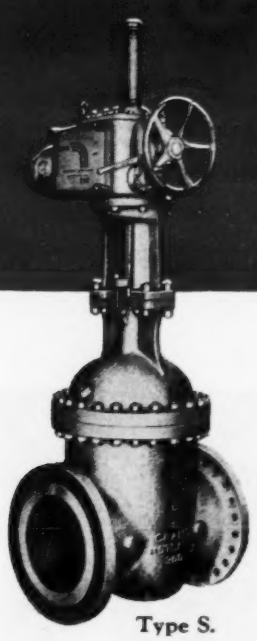
1...DEPENDABILITY

UNDER ALL CONDITIONS

2...EASE OF OPERATION

The outstanding dependability of LimiTorque Controls is important for two reasons . . . it assures unfailing operation of valves, sluice gates or similar equipment under any condition and also assures a great saving in maintenance. Reports from many central stations, power plants, etc. where LimiTorque Controls have been installed indicate they require practically no maintenance.

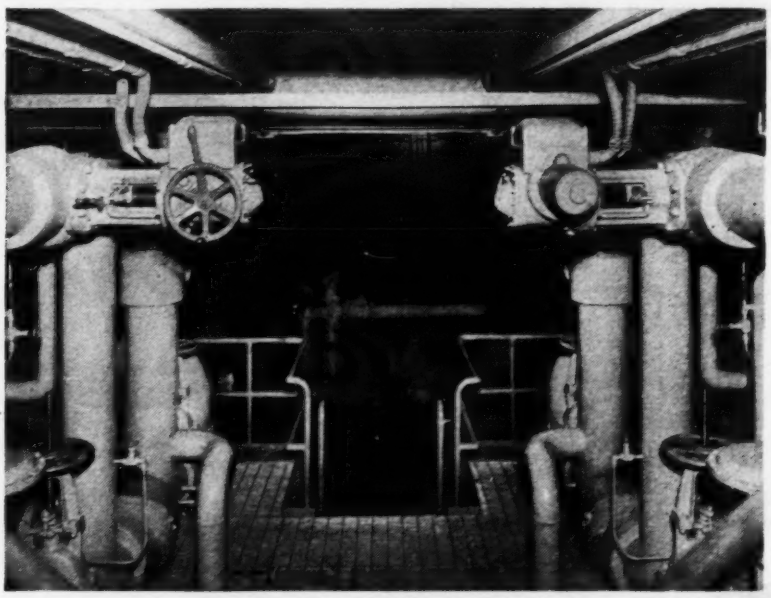
LimiTorque is extremely simple to actuate . . . just by pushing a button at a conveniently located push-button station or a master control panel, valves up to 96" diameter may be opened or closed. It makes remote valve control practical from one central point with a full knowledge of the status of valves at all times.



Type S.

Several types of LimiTorque Controls are available for varied requirements on all types and makes of valves . . . also they can be adapted to existing equipment. Where it is not practical to fit the controls directly to the valve yokes, floor stands can be provided.

In your plans for post-war new construction or the modernization of present plants, include LimiTorque Controls. We'll gladly supply full details.

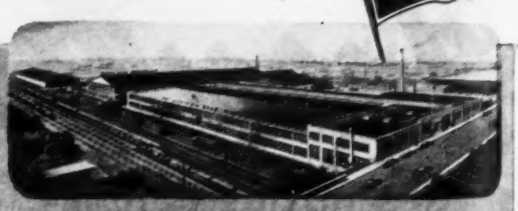


Part of a group of LimiTorque Controls installed in a hydro-electric plant.

Philadelphia

GEAR WORKS INCORPORATED

ERIE AVE. AND G ST., PHILADELPHIA 34, PA. NEW YORK • PITTSBURGH • CHICAGO



Industrial Gears and Speed Reducers
LimiTorque Valve Controls

And YOUR chances of finding a roll of GOLD SEAL Tape that's under par are even less!

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal Specifications

NOT A CHANCE of finding a roll of Gold Seal Tape that's under par . . . that ravels, or peels, or smears your hands, or doesn't stick to the job!

That's because Jenkins controls processing of Gold Seal Tape scientifically. Each batch of compound is laboratory checked. The tensile strength of each bolt of base fabric is tested. Every step in production is rigidly supervised.

Finally each roll of Jenkins Gold Seal Tape is snugly wrapped in cellophane, sealed and sturdily boxed. So when it reaches you, it's sure to be as fresh as the day it left the factory! Jenkins Bros., Rubber Div., 80 White St., New York 13.

JENKINS

Gold Seal Tapes

FRICTION and RUBBER TAPES

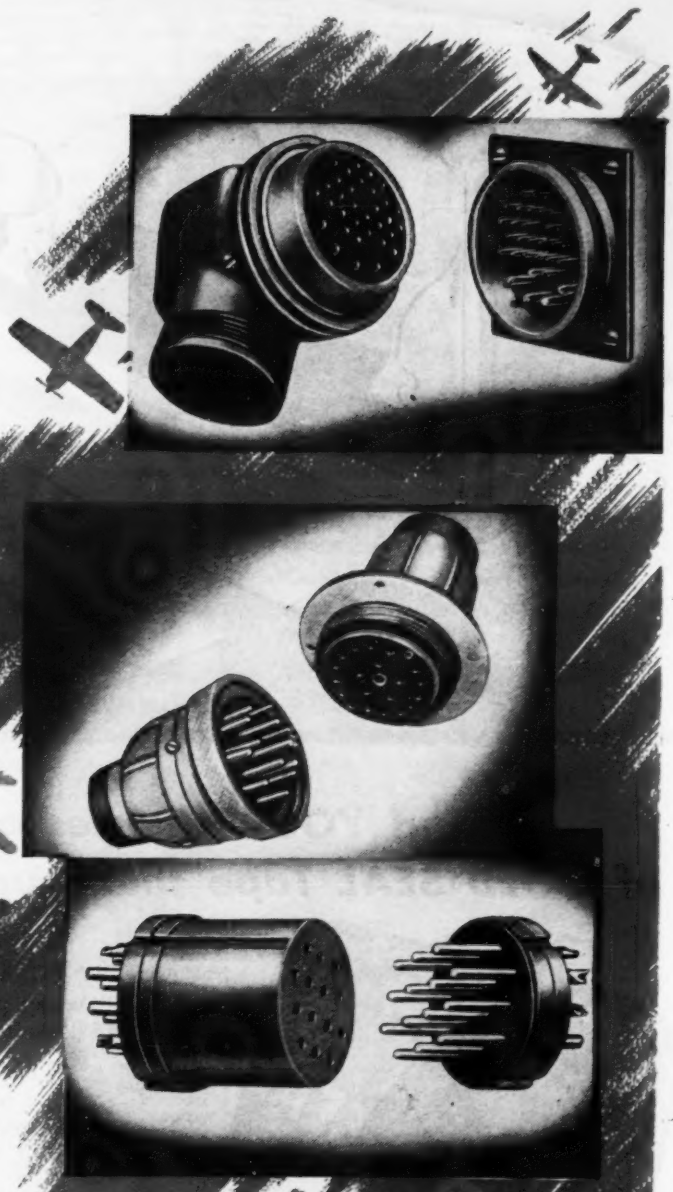
MADE BY JENKINS BROS. . . . MAKERS OF FAMOUS JENKINS VALVES

Melmac Connector Inserts Minimize Arc-Tracking Failures!

In the dripping, hot climate of the tropics, electrical equipment for warfare is exposed to rain, swamp, mud, mildew and fungus attack. If flashovers or arcs burn a conducting path across wet or muddy inserts, insulation breaks down—equipment *fails!*

Danger of such trouble is minimized with MELMAC* plastic insulation parts. When MELMAC is used for the inserts in connectors for electrical circuits, arcs may flash across its surface and burn off or evaporate foreign matter, but the *dielectric qualities of the plastic remain unchanged!*

Mineral-filled MELMAC plastics (592 & 6105C) meet joint Army-Navy Specification J.A.N.P14 under G-2 Classification as an arc-resistant thermosetting molding compound. They are also readily adaptable to mass production of many electrical parts, such as switches, circuit breakers, terminal blocks, and industrial controls. Your inquiry on the use of MELMAC for electrical applications to meet your own specialized requirements will receive prompt attention. **Reg. U. S. Pat. Off.*



AMERICAN CYANAMID COMPANY
PLASTICS DIVISION
30 ROCKEFELLER PLAZA • NEW YORK 20, N. Y.

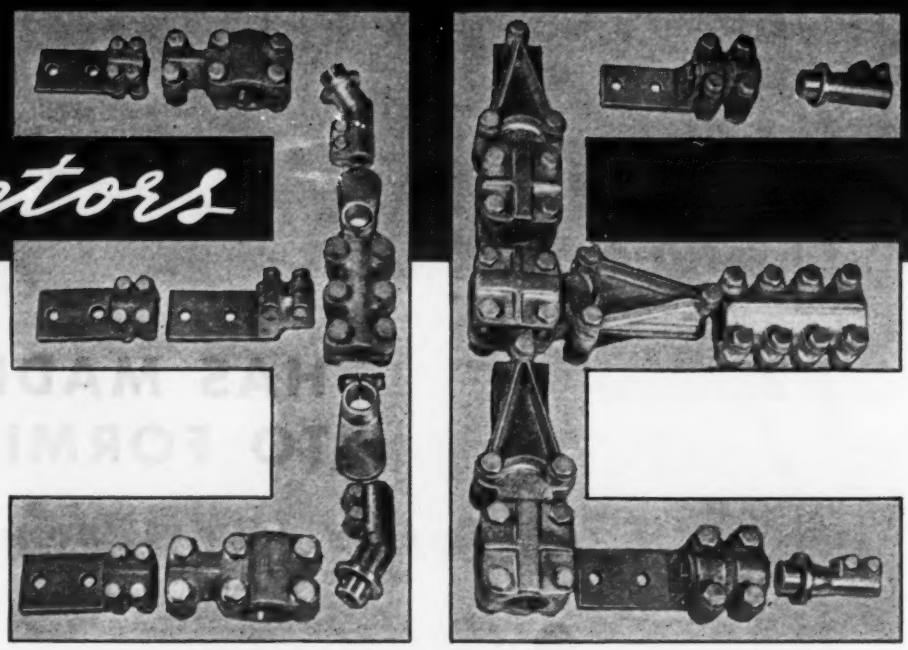
★

In multiple contact cable connectors, such as these for aircraft electrical circuits in commercial and combat ships, MELMAC plastic parts mean dielectric safety and uninterrupted performance.

Cyanamid Plastics

Beetle · Melmac · Melurac
Laminac · Urac

A POWER CIRCUIT IS ONLY AS GOOD AS ITS *Connectors*



To make sure that your connectors are at par with other vital circuit equipment, Specify . . . THREE E.

"3E" POWER CONNECTORS

HAVE THE FOLLOWING FEATURES . . .

★ *Made of high conductivity copper or copper alloy*

★ *Properly proportioned for all electrical and mechanical requirements*

★ *Carefully machined for good and lasting contacts*

★ *Designed for easy installation.*

OUR BULLETIN No. 401 lists a large variety of connectors for bar, tubing, cable, and wire. They are made in clamp style solder or shrink fit. Expansion connectors and grounds fittings are also listed. Every Distribution Engineer should have a copy. Write for yours.

Keep the Power Flowing

WITH

"3E" POWER CONNECTORS

THREE

ELECTRICAL ENGINEERS EQUIPMENT CO.
MELROSE PARK ILLINOIS

Recent Progress

HAS MADE AVAILABLE TO FORMICA:

- *Better Fibre Bases Such as Glass*
- *Better Resins*
- *Better Production Methods*
- *Better and More Accurate Test Information*

FORMICA'S service to the electrical engineer and the electrical manufacturer, under the pressure of war research, has improved more rapidly during the past few years than usual.

New fibre bases such as glass have made possible high frequency insulation of excellent quality—comparable for many purposes to ceramics—which can be readily machined—which is easily workable in production.

New resins such as melomine have intensified the useful qualities of many Formica grades.

Infra-red treating machines, electronic heat for curing thick sections, new types of tube rolling machines, are features of newly developed equipment that make possible better quality in greater volume.

A large investment in the most modern testing equipment has enabled the Formica laboratory to give more accurate, detailed and valuable answers to the engineer's questions regarding the exact physical and chemical characteristics of the material.

Why not make use of this exceptional equipment for service? Send in your inquiries.

FORMICA

THE FORMICA INSULATION CO. • 4630 SPRING GROVE AVE. • CINCINNATI 32, OHIO

(Above) Recommendation by engineer was: Lamp—1000-watt, S-52 clear bulb; Luminaire—medium distribution Millite, for ½" conduit mounting; mounting height—45 feet; average illumination in service—20 footcandles. Accepted and installed.

(Below) Job-requirements given to engineers called for illumination on large and small presses, close vision in setting up and repairing dies, 40-foot height to clear crane, protection from oily dust.

. . . AND ASK FOR A WESTINGHOUSE ENGINEER

Whatever your work—whether it's fine machining . . . or precise inspection . . . with low ceiling height . . . or in oil mist—give these and the other job-requirements to the Westinghouse engineer.

And beyond that point, you can depend on him to meet your requirements—the same as you depend on others to meet specifications.

The most practical combination of lamps (incandescent, fluorescent, mercury, etc.), intensities, diffusions, distributions, colors and so on, is best planned with the aid of the lighting engineer who has:

1. *A broad line of lighting equipment.*
2. *Wide experience in industrial lighting applications.*
3. *Periodical laboratory schooling.*
4. *Data on latest development work.*

These four fundamentals are found only in the Westinghouse lighting engineer. One of these trained men may be reached through the Westinghouse Distributor nearest you. Give him your job-requirements . . . get his analysis and recommendations. Westinghouse Electric & Manufacturing Co., Edgewater Park, Cleveland 1, Ohio.

J-04020

Dust-tight, vapor-tight Millite. Watts: 300 to 1000 incandescent, 400 mercury.

Locklite
100 to 1500 watts

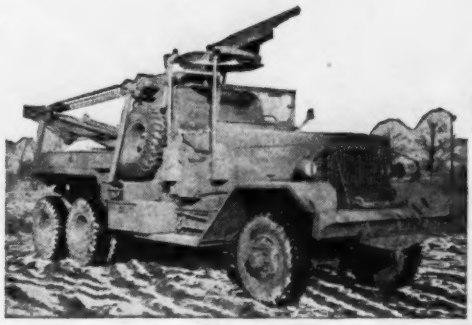
Silvered Bowl Diffuser
300 to 500 watts

FPR Fluorescent
40 and 100 watts

FP Fluorescent
40 and 100 watts

Westinghouse *Lighting*

WHEN "BIG BOY" TAKES OFF HIS UNIFORM



● All over the world, where the going is toughest, the M1A1 Army heavy wrecker has earned its reputation as the biggest, toughest, pullin'-est bruiser on wheels. These super trucks, built by Ward LaFrance Truck Division for the Ordnance Department, are used for such jobs as tank recovery, motor vehicle rescue, lifting and carrying disabled bombers. They operate in the mire of European swamps . . . the muck of Asiatic jungles. To the M1A1 wrecker, a road is a convenience, rather than a necessity . . . In the near future, Ward LaFrance commercial trucks and tractors will again appear on America's highways. These Ward LaFrance over-the-road trucks and tractors are designed to haul pay loads faster and more economically than ever before. They are not streamlined like a sport coupe, but they look like what they are: the biggest, toughest, sturdiest motor trucks on the highway. They are backed by the twenty-five year Ward LaFrance reputation for building great trucks, further proved by unbeatable performance all over the world.

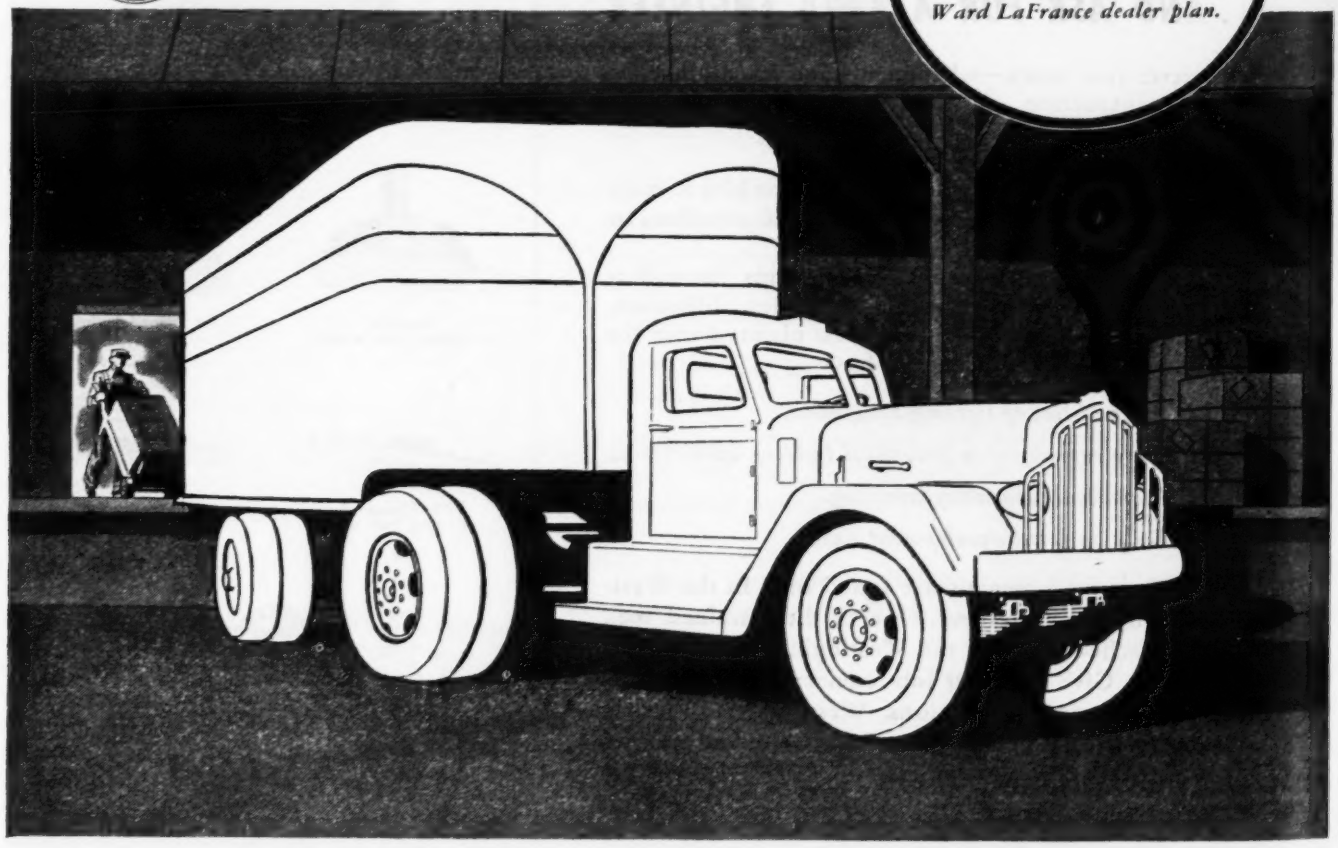
WARD LaFRANCE

TRUCK DIVISION

GREAT AMERICAN INDUSTRIES, INC.

ELMIRA • NEW YORK

FRANCHISES ARE AVAILABLE
to alert dealers in a number of attractive territories. Leading dealers now handling smaller, non-competitive trucks will be especially interested in the Ward LaFrance dealer plan.



BLAW-KNOX and the voice of radio

Blaw-Knox Towers have played an important part in radio since the early days of Marconi. Most Radio Towers*, here and abroad, are of Blaw-Knox design or manufacture. Blaw-Knox's importance in military electronic development cannot now be disclosed.

What Blaw-Knox means to radio, it means to many other industries. If you are concerned with modern methods for converting raw materials to usable products by chemical or mechanical means, or solvent recovery . . . or any ramification of industrial processing, Blaw-Knox can carry on from pilot plant to full scale production.

Blaw-Knox can serve in other ways: with prefabricated piping, equipment for the steel industry and a broad line of construction equipment, to name a few. Let us discuss your problems with you—at your convenience.

*The Tower is an essential part of the voice of radio. Blaw-Knox Towers (some over 1000' high) are used for broadcasting, communications, navigation, television, facsimile, police work . . . as well as for undisclosed electronic purposes.

BLAW-KNOX COMPANY

PACEMAKER FOR AMERICAN INITIATIVE AND INGENUITY

2013 FARMERS BANK BLDG., PITTSBURGH, PA.

LEWIS FOUNDRY & MACHINE DIVISION, Rolls and Rolling Mill Machinery

POWER PIPING DIVISION, Prefabricated Piping Systems

COLUMBUS DIVISION, Ordnance Matériel

SPECIAL ORDNANCE DIVISION, Bofors Anti-Aircraft Gun Mounts and Mechanisms

BLAW-KNOX DIVISION, Chemical & Process Plants & Equipment, Construction Equipment, Steel Plant Equipment, Radio & Transmission Towers . . . General Industrial Products

PITTSBURGH ROLLS DIVISION, Rolls for Steel and Non-Ferrous Rolling Mills

UNION STEEL CASTINGS DIVISION, Steel and Alloy Castings

NATIONAL ALLOY STEEL DIVISION, Heat and Corrosion-Resistant Alloy Castings

MARTINS FERRY DIVISION, Bofors Anti-Aircraft Gun Mounts

BLAW-KNOX SPRINKLER DIVISION, Automatic Sprinklers and Deluge Systems

A FEW VICTORY PRODUCTS

ANTI-AIRCRAFT GUN MOUNTS · GUN SLIDES · LANDING BARGES · SYNTHETIC RUBBER PLANTS · PIPING FOR NAVAL VESSELS · POWDER PLANTS · ROCKETS · 16" PROJECTILES · CAST ARMOR FOR TANKS & NAVAL CONSTRUCTION · CHEMICAL PLANTS

Where Heat, Flame, Oil, Moisture, Grease and Corrosive Vapors will be encountered — —

Use NATIONAL ELECTRIC ASBESTOS AND ASBESTOS-VARNISHED CAMBRIC WIRES AND CABLES

For temperatures higher than permissible limits for rubber, NE\on (thermoplastic) and varnished cambric insulations, we recommend National Electric asbestos, asbestos-varnished cambric and asbestos—NE\on (thermoplastic) insulated wires and cables. Complete engineering data and literature sent on request.

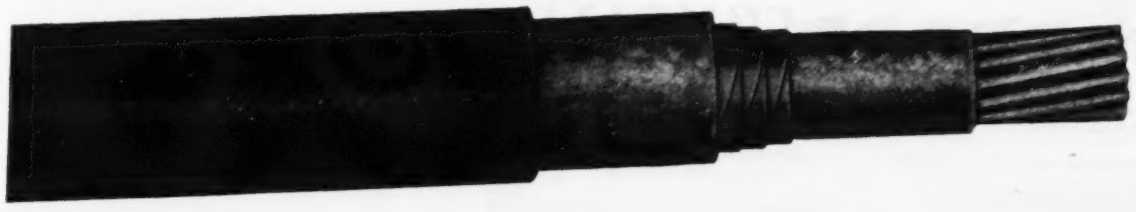
NATIONAL ELECTRIC PRODUCTS
NE
WIRING SYSTEMS

ALL ASBESTOS WIRE AND CABLE

Sizes No. 18AWG to 1,000,000 CM.—For wiring rheostats, stoves, switchboards and electrical equipment exposed to heat or fire hazard. Also for general open wiring in hot locations. 300 and 600 volt ratings. Max. operating temperatures 200°C (392°F) and 125°C (257°F) respectively.

ASBESTOS-VARNISHED CAMBRIC CABLE

Sizes No. 18AWG to 1,000,000 CM.—For power circuits and general hot spot wiring in boiler rooms, steam tunnels, etc. 600 to 8000 volt ratings. Max. operating temperatures 110°C (230°F) and 91°C (196°F) respectively.



National Electric
PRODUCTS CORPORATION
Pittsburgh, Pa.

Electrical World

APRIL 14, 1945

Desire Is Not Decision

ONE BY ONE they piled up, orders for electric water heaters. Well, not orders exactly, but names of people who wanted to buy water heaters as soon as any could be had, hot prospects, every one of them. There was a total of 58 people, each one impatiently waiting for an electric water heater.

Anxious to help its customers, the power company tried to find some heaters for them. But the few left in manufacturers' and distributors' stocks when production stopped had been sold long ago. Then it was learned that a certain manufacturer had received a spot authorization and would produce a limited number, of which, by great good luck, the particular power company was able to obtain a carload, 88 heaters. With 58 customers clamoring, there certainly must be plenty of others who would gobble up the remaining 30 as soon as they knew they were available.

That's what was thought. But it didn't turn out that way.

Pleasant, indeed, it was to notify the 58 they now could have the water heaters for which they yearned. That was practically the end of pleasure in the affair. There was no rush of happy purchasers, overjoyed to obtain their hearts' desire. On the contrary, the power company had to do some pretty intensive selling to persuade 15 of the 58 to buy the heaters they had said they wanted so badly.

By this experience the particular power company learned again the importance of the name on the dotted line, something that sanguine sales plans are prone to overlook in estimates of future markets. Although the words start with the same two letters, there is a big difference between *desire* and *decision* to buy.

During the war years production of gas ranges has been maintained at a fairly high level. Of late months the models turned out have been highly desirable appliances, that is, for gas ranges. But, as far as we can observe and as inquiry informs us, the customers have not been flocking in with wheelbarrows and kiddie carts to carry these ranges home. Instead, sales floors seem to remain pretty well populated with the new models and probably there are plenty more of them in warehouses and stockrooms. These ranges are not moving, we are told, for the reason that sales manpower is lacking. And they cannot be expected to move without sales push.

That is exactly what that power company found out when it secured the water heaters for its 58 waiting buyers—that sales push is essential. Indications are that many other power companies are going to wait for experience to teach them this grand lesson. They figure that the market, starved during the war, will avidly absorb all the electric appliances that can be produced in the first year or so after the war; that the problem will not be to sell appliances or to promote the sale of them, but just to see that its customers get their proper share.

It is true that there will be limitations on appliance production during the first post-war year, possibly for longer. But it is not true that even this limited volume will be snapped up by waiting buyers and selling thus can take a recess. There always has been and there always will be a lot of evaporation in the process of boiling down *desire* to buy into *decision* to buy.

Indexes and Curves Evaluate Quality of Customer Service

Monthly records of system performance, including a system reliability index, guide studies of system operation; show where performance can be improved most readily; where further improvement of performance is limited to a small margin at high premium of cost

H. C. COLTERYAHN, Union Electric Co. of Missouri, St. Louis, Mo.*

FACTS, in any concern, should serve as the basis for improvement of performance and economy. This is no less true in distribution engineering, design and operation. When properly used facts should show not only where performance can be improved most readily but also where further improvement of performance is limited to a small margin at a high premium of cost.

Under this philosophy reports of transmission and distribution operations and "trouble" on the Union Electric system have, since 1941, been summarized in a monthly report which is used, along with a "service reliability index" and related charts, to evaluate equipment performance and quality of service on the system.

Still considered as in an experimental stage, none of the features of performance shown by the data and curves are yet accepted as an entirely adequate index of performance although much progress has been made. However, the report does present a condensed monthly indication and comparison of the quality of performance of each component part of the system and as such the facts are closely scrutinized.

Analyze Outages

First portion of each month's report is a condensation (see Table I) of the month's outage record and the load affected. Included are a statement of any outstanding trouble occurrence of the month and three sets of system reliability indexes.

Table I—Monthly Outage Record (August 1944)

	Number	Est. Kva. At Peak	Est. No. of Cust.	Cust. Hours Outages
Substation outages	4	9,238	48	6.2
Circuit interruptions, 66 kv	1	5,800	39	2.6
Circuit interruptions, 33 kv	51	49,674	19,784	17.4
Circuit interruptions, 11/13 kv	18	30,577	6,038	4,916.9
Circuit interruptions, 2.4–4.16 kv	23	10,355	13,168	909.0
Wires down, 2.4–4.16 kv	49	2,413½	3,743	7,943.4
Line cutovers, 2.4–4.16 kv	11	1,427	855	45.2
Line fuses blown, 2.4–4.16 kv	41	3,081½	1,677	2,599.1
Transformer failures	12	140½	68	161.9
Transformer cutovers	6	122½	55	14.2
Transformer primary fuses blown	75	629½	528	605.5
Secondary wires down	21	22	26	47.5
Service wires down	103	39½	78	83.2
	415	113,520	46,107	17,322.1

Line switch failures, 1
Fuse switch failures, 7
Lightning arrester failures, 15

	System Expectancy Index (1)		System Continuity Index (2)	
	This Month	Past 12 Months	This Month	Past 12 Months
Total includes momentary	0.69	0.45	61.10	48.60
Long-over 1 minute	2.24	1.87	61.10	48.60
Long-over 5 minutes	3.87	2.37	60.10	47.90

Notes. 1. *System Expectancy Index* is the average period in years between service interruptions to the average customer, if the interruptions continue at the same rate as during the period under consideration.
2. *System Continuity Index* is the number of customer hours outage per million customer hours use.

A breakdown of outages (see Table II) is also compiled in which outages are classified by class of system equipment responsible for the outage rather than by circuit voltage or type of trouble, as in Table I. For example, a "circuit interruption, 33 kv." appearing in Table I might be included in Table II either in the "subtransmission" or "feeders" classification; the choice depending on whether the circuit supplied a distribution substation or was a direct supply to large industrial customers. A second part of Table II (not shown) groups the same outages according to the geographical divisions of the Union Electric System. Details of outage in both are the same and self-explanatory.

Present dividing line between "momentary" and "long" outages is one minute. Outages of one minute or less are considered momentary, while anything over that comes under the classification of "long". This separation is made because many outages of a minute or less result from normal or expected equipment operations and inclusion of them in any analysis would cloud the real picture of outages and trouble which require corrective measures. Some time ago a dividing point of 5 min. was considered aiming to more correctly separate the two classes mentioned. However, since most of the outages between 1 and 5 min. have the same causes as long outages, the dividing point was left as 1 min.

The "kva. affected" figures do not

* Senior Assistant Distribution Service Engineer

Table II—Breakdown of Outages (August 1944)

Summary of Interruptions by Parts of System	Customers Served	Total Outages	Outages Affecting Load: Momentary	Outages Affecting Load: Long (1)	Total Kva. Affected	Customers Affected: Momentary	Customers Affected: Long	Customers Affected: Total Percent (2)	Average (3) Length of Long Outages: Minutes	Customer Hours Outage	Service Reliability Index — Expectancy Index: This Month	Expectancy Index: Past Twelve Months	Continuity Index: This Month	Continuity Index: Past Twelve Months
Union Electric System — Total	380,893	415	69	330	113,520	31,921	14,186	12.10	73.3	17,322.1	0.69	0.45	61.10	48.60
Bulk Power Supply	.....	0	0	0	.....	.....	.....	.....	.....	.....	.....	11.27	.....	0.60
Generation	.....	0	0	0	.....	.....	.....	.....	.....	.....	∞	∞	0	.....
Major Transmission	.....	0	0	0	.....	.....	.....	.....	.....	.....	.....	11.27	.....	0.60
Substation and Supply	.....	34	21	8	50,794	20,404	5,429	6.78	54.2	4,900.9	1.23	0.69	17.30	7.46
Subtransmission	.....	30	20	5	41,556	20,404	5,351	6.77	54.5	4,894.7	1.23	1.12	0.02	2.90
Substation	.....	4	1	3	9,238	.....	48	0.01	7.8	6.2	833.00	1.85	17.28	4.56
Distribution	.....	381	48	322	62,726	11,517	8,757	5.32	85.2	12,421.2	1.56	1.45	43.80	40.54
Feeders	.....	63	39	20	54,850	10,620	2,624	3.47	21.7	951.2	2.40	1.98	3.35	10.01
Primary Mains	.....	101	9	90	6,922	849	5,426	1.65	116.8	10,557.7	5.04	6.73	37.24	26.46
Transformers	.....	93	.....	91	892½	48	603	0.17	77.7	781.6	49.00	30.95	2.75	3.55
Secondaries	.....	21	.....	18	22	.....	26	0.01	109.6	47.5	833.00	1000.00	0.17	0.15
Service Wires	.....	103	.....	103	39½	.....	78	0.02	64.0	83.2	417.00	400.00	0.29	0.37

Notes 1. The term "momentary" applies to outages of one minute or less duration; the term "long" applies to outages longer than one minute.
2. "Total percent" includes customers affected by both "momentary" and "long" outages. In the breakdown "By Parts of System", the figure is the percent of the system total.
3. The "Average length of long outages" is obtained from outages of over one minute duration. A single outage may affect two different divisions.

have much meaning, in themselves, but they do furnish a measure of the magnitude of the loads affected.

Customers affected by the various outages are divided into those affected by momentary and long outages. "Customer hours outage" is the accumulated products of the number of customers affected and the length of the outage. From this the average length of long outages is obtained.

On the right side of Table II is shown what is termed a "service reliability index" and which contains an "expectancy index" and a "continuity index."

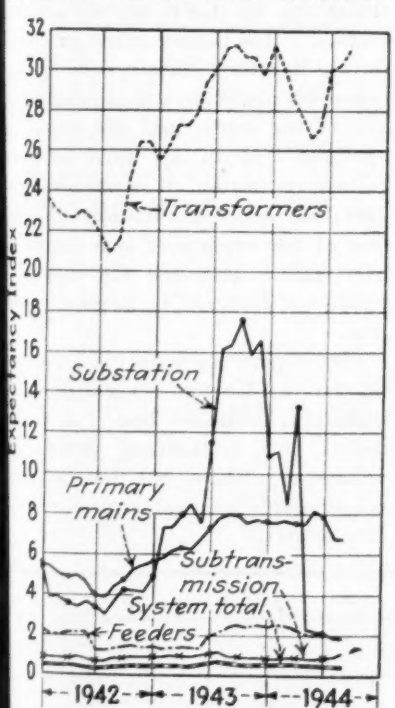


CHART I—Expectancy indexes show the average number of years between service interruptions to the average customer. Curves reveal that outages in subtransmission equipment affect many more customers than any other system element

Expectancy Index is a measure of how often an average customer experiences a service interruption, either "momentary" or "long". It is the average period in years between interruptions to the average customer. The figures have been put in this form so that they present the quality of performance of each of the physical parts of the system and of each company or division of the system on a base which lends itself to ready comparison, and yet each individually retains an absolute and concrete meaning. That is, if we take several figures from any group, we can compare them on a purely qualitative basis and easily see which figure represents the best performance. Now, if we pick out any single figure, it also has an absolute meaning in a quantitative sense. For example, the expectancy index for "feeders" is 1.98. In a qualitative sense this figure shows that its performance is better than that of subtransmission. By itself, it means in a quantitative sense, that if feeder outages continue at the past year's rate of occurrence, the average customer will have one outage every 1.98 years.

There are two sets of expectancy indexes, labeled "this month" and "past twelve months." "This month" indexes are calculated on the basis of the performance during the month talked about. The indexes labeled "past 12 months" are based on the performance of the past year; they are weighted—average figures. Since both are in units of years they are immediately comparable and show whether this month's performance was above or below the past year's performance.

Outage Hours Measured

Continuity Index is the number of customer hours outage per million customer hours use. Customer-hours outage is obtained from the product of number of customers affected and length of outage. Customer hours use is the product of total number of customers served and the total number of hours service is available for use. This index, like the expectancy index,

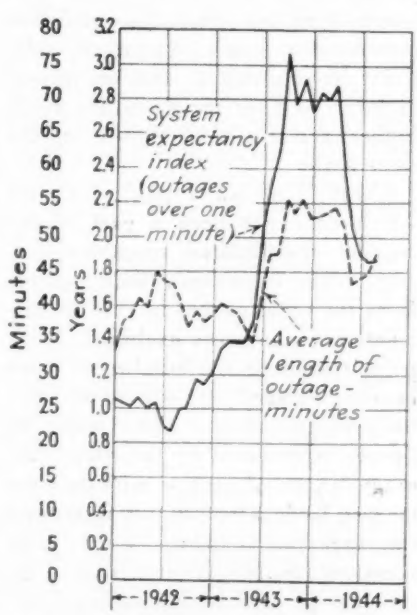


CHART II—Modified expectancy index shows years between outages over one minute that average customer may expect and the duration of the one outage which the average customer can expect in the years represented on expectancy curve

has both qualitative and quantitative meanings. Because the percent of customer hours outage is so small, this index has been figured on a base of a million customer hours use. To make it more comprehensible, we expect to change this unit of the continuity index to "customer minutes outage per year of use." Each figure will then be approximately one-half of its present magnitude and will mean the number of *minutes* outage per *year* instead of the number of hours outage per million hours used.

The value of these indexes is not in the figures alone but also in curves plotted from them. There are normally five sheets of curves circulated with the monthly summary. All are curves of expectancy indexes, as we have not yet prepared any curves of continuity indexes. An example of these curves is Chart I, the data for which were taken from the top set of figures on the "service reliability index." Other curves (not shown here) present breakdowns; these are by geographical divisions of the system, of total outages, sub-transmission outages, feeder outages, and transformer outages.

Sub-Transmission

From the curve it can be seen that outages in the sub-transmission class of equipment affects many more customers than any other class, and that transformers cause outages to relatively few customers. Indexes of secondaries and service wires are much higher and can't be shown on the same scale.

Chart II shows a pair of curves which have not been a part of the regular consolidated monthly summary. The expectancy index differs from the other curves in that all momentary outages are excluded. Each point represents the number of years between outages over one minute that the average customer can expect. The figures represented by the curve "average length of outage minutes" are derived from the continuity index and the expectancy index. Each point represents the length in minutes of the one outage which the average customer can expect in the years represented by the corresponding point on the expectancy index curve. Using a concrete example, based on the performance of the past 12 months ending with August, 1944 the average customer can expect one outage every 1.87 years. This outage will be 48 minutes in length.

These latter two curves are examples of what can be done with the records provided by the expectancy and continuity indexes. Examination of these and other curves should reveal what class of equipment or what division of the system has a performance record out of line with the corresponding parts. Further investigation should disclose the cause of the poor record and prove or disprove the need for corrective measures.

Long-Rural Voltage Temporarily Corrected

By M. M. DEVORRIS

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With the restriction of materials which was instituted early in the war emergency period, practically all conversion work to higher voltages, of necessity, came to a halt. Where a number of old 2.3-kv. rural circuits existed, increased loads created low voltage conditions, which necessitated some corrective measures, due to the poor operation of many of the milking machines and milk coolers.

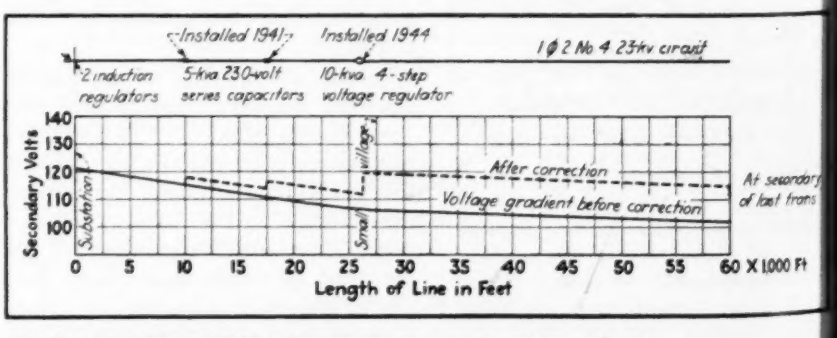
One of these circuits was a single-phase, 2.3-kv. rural line about eleven miles long, which emanated from a distribution substation serving a small rural community. This circuit had been extended until in 1941 it was slightly over eleven miles in length. The source of this circuit was regulated by the use of two induction regulators, in order to take care of the wide variation in voltage at the substation brought about by its being connected to the middle of a long transmission line which carried a rather heavy industrial load.

Since customers were distributed through the entire length of this 11-mile line, and because it was hoped that it could be converted to 6.9-kv. operation at the first opportunity, the first remedial step was the installation of two small series capacitors at two points on the line where the most customers would be benefitted. Gradual increase in load on this circuit finally brought about the more recent corrective step in the form of a 10-kva., four-step voltage regulator, which was installed just ahead of a small rural village served from this circuit at a point about five miles out of the substation.

As soon as material restrictions have been lifted, this circuit will be converted to 6.9-kv. operation, and the series capacitors and regulator eliminated. Series capacitor as a voltage regulating device has been very effective, and in these instances no expensive protection for the capacitors was installed.

A small, low voltage copper oxide disk protector was used for several years on each of the capacitor installations, but due to the repeated operation of the copper oxide protector during lightning storms, even this inexpensive protector was eliminated on one of the units, and the capacitor operated without any form of over-voltage protection. It is interesting to note that about the middle of 1944 one of the capacitors was found to have failed, although the disk protector was found to be in good condition.

Our experience with the series capacitors at this and several other installations, indicates that it is a very useful and economical device for voltage regulation, but that the present available low cost protector is not satisfactory.



FOUR-STEP REGULATOR aids series capacitor in raising voltage

Self-Supporting Cable Adaptable, Successful

Seven year record of cable used for numerous functions, including submarine, reveals only one internal fault but tough resistance to external assaults and tree loads—Rust and lightning protection necessary—Installation includes 11,000 ft. in six sections

G. S. WILCOX, Philadelphia Electric Co., Philadelphia, Pa.

SELF-SUPPORTING, or "SS" aerial cable has been used on the distribution system of Philadelphia Electric Co. for more than seven years. It has proven dependable and satisfactory for the purpose for which it was originally selected, and has been found to be adaptable to a wide variety of situations.

It is the intent of this article to describe some experiences in the utilization, operation, and maintenance of "SS" cable, as an informal study of the behavior of a comparatively new component of the electric distribution system.

A previous issue (ELECTRICAL WORLD, April 19, 1941) described "SS" cable and its accessories in considerable detail, and there has since been little change in any of the equipment.

Fabrication

Briefly, self-supporting cable of the type used on Philadelphia Electric Co. system consists of one or more copper conductors conventionally insulated with varnish cambric, a jute filler in the 4-conductor types, a containing and protective rubber and fabric belting, and the whole surrounding alternate strands of galvanized high-strength steel and tinned copper. This outer wrapping, the unique feature of the cable, is laid on in the form of an extended helix, roughly one turn every two feet, providing a built-in messenger of great strength plus a large area return conductor which can be held at ground potential.

The cable is supported on the pole by a simple steel saddle suspended from a bent through-bolt. A keeper is bolted to the saddle, not to grip the cable but to prevent any sudden shock from unseating it. In case of severe stress, the saddle is the weak point of the whole installation and should let go before serious damage develops elsewhere.

Dead-ends and splices are held by a clamp consisting of a split cylindrical sleeve, the symmetrical halves of which are bolted together with fitted straps. Between sleeve and cable, lead liners are inserted, which under bolting pressure become rifled into the sheath and form an effective grip. The inner surface of the sleeves is roughed by raised hobs.

Where the messenger strands have to be cut, as at a splice, they are secured by bending them back over the edge of the clamp and holding with an additional strap.

For a splice, a pair of clamps is tied together by two 30-in. links of ¼-in. by 1¼-in. galvanized steel and the splice is made between.

At dead ends, clevis fittings are attached to the end of the clamp and guy wire is used to make the attachment to the pole or whatever anchoring structure is used.

The work of installation is done by an aerial line crew, who pull in the cable over the saddles and clamp it permanently in place, leaving enough slack at the proper points for joints or dead ends. A splicer then takes over and makes up the splices or terminals.

Successive Installations

The first installation of "SS" cable on our system was made in 1937, when about five miles of 2 by No. 8 was erected through a dense tree area, where the cost of line clearance for open wire would have been prohibitive.

Four-conductor cable was first used in June, 1940, when approximately 1,300 ft. of 4 by No. 6 was installed along a rear property line in a high-class suburban area where trees had been a frequent source of outage and the original facilities next to inac-

FIG. 1—Turning a right-angle corner. Left, original squirrel-cage type of clamp which entailed removal of outer stranding—Right, messenger straps bent back and secured, neutral strands bunched and tapped across splice

cessible for patrol or repairs.

There are now four types of "SS" cable in service, totalling about 45 cable miles. Approximately 80 percent is 2-conductor No. 8, and 15 percent is 4-conductor No. 2/0, compact stranded. The remainder consists of 4 by No. 6 and 4 by No. 4.

The 2-conductor No. 8 cable has been mainly used on single-phase extensions, usually in rural areas, to overcome bad tree conditions.

The 4-conductor cable in all sizes has proven extremely versatile. Some uses to which it has been put are:

(1) An express feeder direct from the substation cable termination to circuit distribution center.

(2) Extensions of existing underground feeders.

(3) Feeders from step-down units, enabling such units to be located along the transmission right-of-way without particular regard for surrounding tree conditions or other obstacles. In one such case the cable was attached to the trees.

(4) Extensions to individual customers so located as to make open wire construction extremely difficult.

(5) Avoidance of overhead crossings where highways under-pass railroads or trolley lines.

Submarine Use

One other installation serves a purpose for which the cable was definitely not intended, but when it was tried it was not found wanting. When the bridge over the canal at Chesapeake City, Maryland, was wrecked by a vessel out of control, the only source of electricity for Chesapeake City went with it. As an emergency measure, several hundred feet of 4 by No. 4 "SS" cable was hauled across the canal and, as submarine cable, picked up the load of the town. The bridge was never rebuilt, the "SS" cable showed no apparent resentment at its watery environment, so it was left there. About a year later it was fouled, presumably by a dragging anchor. It was replaced, again as submarine cable, and is still carrying the load.

One Internal Fault

Durability of the cable in all its normal uses has been outstanding. There has been only one failure which could be called a purely cable fault. This occurred about midspan near the load end of a 4 by No. 2/0 feeder extending from Manayunk Substation to the center of a distribution circuit. The initial fault had apparently been phase to ground, but, the short circuit current at this point being rather high, one reclosure was sufficient to involve all three phases. However, damage to the cable was surprisingly light. Although the phase conductors were practically burned off, only five messenger strands were severed out of the total of twenty-two. To make repairs, a standard splicing clamp assembly was installed, straddling the fault, the faulted section was cut out, the stranding clamped back and a regular splice made up. The loss of conductor was made up by cutting in short pieces of No. 2/0 solid, which in diameter matches No. 2/0 "compact" stranding. No cause has ever been established for this failure, although there is a possibility that it was hit by a small caliber rifle bullet.

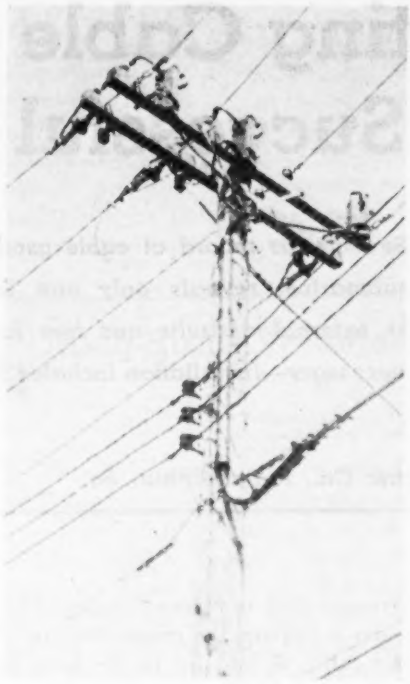


FIG. 2—Termination of SS cable (four No. 2/0)

Incidentally, the run of cable in which this fault occurred was the first 4 by No. 2/0 cable installed and was the "Guinea pig" from which we learned a great deal, even before it was in service. A "squirrel-cage" type of splicing and dead-ending clamp had been developed by the manufacturer, in cooperation with our engineering group, and had been used in this original installation. These clamps required a special jig which was used on the ground to make up the splice or dead end. To erect the cable it was necessary, first to pull it in to sag and snub it while the ends were measured and marked, then it was dropped back while the splices were made up, and finally it was resagged and tied in. The entire run consisted of five 2,000-ft. lengths and one 1,000-ft. length, a total of 11,000 ft.; with a set of sectionalizing boxes cut in at approximately the midpoint. The cable was energized, phased out, and left to soak overnight.

Next morning, a routine recheck of phasing, before picking up load with the cable, showed one phase open. Further checks indicated that whatever the trouble was, it was still progressing and the cable would soon be completely devoid of continuity. Suspicion immediately settled on the splices and when they were opened, it was found that practically all the connectors had torn loose and that separation of the conductor ends from ¼-in. to 2-in. had occurred.

It was pretty clear what had happened. The messenger strands, as they adjusted themselves to the strain, had lengthened their coils just enough to transfer some strain to the copper conductor and hence to the joint. Most of the lengths being 2,000 ft., only 0.001 in. lengthening per foot would mean an appreciable difference in relative lengths of copper and messenger strands. It was this occurrence that led to the design of the present clamps with which the cable can be completely sagged and anchored before any splices are made.

Other Failures External

We have had three other failures involving the outer stranding of the 4-conductor cable, all of which were due to external causes.

One in the Eastern division occurred not long after the installation of a short stretch of cable through a highway underpass. Dissection showed definite signs of crushing, possibly by a rifle bullet or by a projection from a passing vehicle.

Another in the Western Division was definitely proved to have been caused by a youthful sharpshooter with a 0.22 caliber rifle. The manufacturer originally claimed that this cable was immune to the hazards of the hunting season, but experience to date indicates that it will not withstand gunshots, at least of fairly close range.

The third failure occurred where

4 by No. 4 "SS" cable had been installed through a semi-circular stone arch under a railroad. The cable had been strapped directly to the masonry at the highest point in the arch. This position was thought to be safe from damage from any vehicle which might use the underpass. However, the unlikely happened. A junk dealer's derrick truck, with the boom partially raised, attempted to go through and the driver miscalculated his clearance by about 2 in. There was slightly more vertical clearance on the side where the truck entered than on the outgoing side. About 3 ft. from the exit, the boom came in contact with the cable, which resisted for about 2 ft. and then failed under the increasing crushing force. It was necessary to cut out about 4 ft. of cable to repair the fault, but since the cable terminated at the customer's pole only a span away, we made up only one splice at the fault and lengthened the clamp support at the terminal pole, making up the loss of conductor with single-conductor non-leaded cable.

In none of the foregoing instances was enough messenger strand destroyed to let the cable down. This is, of course, no guarantee that under proper fault conditions it will not burn completely off, but so far the evidence is strongly in favor of its staying up.

Moisture Causes Fault

Another failure occurred at a sectionalizing point and involved the portion on the dead-end side of a clamp; that is, the portion where the armor had been removed. This fault was apparently due to weathering and splitting of the unsheathed belting, allowing moisture to enter the cable. Inspection of other similar locations revealed that there was a variation in the way the belting absorbed insulating paint, so, as an added precaution, two layers of V.C. tape were added and sealed with another coat of paint.

There have been no subsequent cases in which the 4-conductor cable has been put to a severe mechanical test such as the one described in the earlier article, where a large tree, overburdened with wet snow, fell across the cable, bringing down with it two poles, street light wires and fixtures, two telephone cables, and some open wire scheduled for removal but still energized. Out of this wreckage the cable was picked up and re-installed, unharmed except for one broken copper strand. Had it not been for the electrical set-up of the circuit at the time, there would have been no interruption to service, since the tripping that occurred in no way involved the cable.

Stays in the Air

The attention paid the more spectacular 4-conductor cable has somewhat over-shadowed the job the 2-conductor No. 8 has been doing. It has an even more remarkable record than the larger cable, because, although it has been used longer, there is no record of any true failures.

There have been some cases where the stress cones or "knobs" at the terminations have broken down, for which the cable can in no way be blamed. A failure occurred on the original installation, apparently caused by a shotgun at fairly close range. Another 2-conductor installation broke down because it was too close to a burning building, and in so doing showed off another of its advantages. About 25 ft. of the cable was burned to a crisp. Naturally, it shorted and blew the branch fuse, but it stayed in the air, and if it had come down, would have came down de-energized. Open wire might have dropped to the street, alive and lethal, and before the fuse blew, somebody might have been hurt.

In two cases good size trees have fallen on the No. 8 cable without harm. These trees were of such size that a line crew with a boom truck was necessary to lift them off the cable. The cable sagged, aplenty, but the fact that it is not held rigidly in the saddles, enabling the entire length to help take up the shock, is apparently of great value in such an extremity. In these instances, there was no apparent damage to the enclosing strands.

Rust Prevention

One of the important items of maintenance on "SS" cable is the prevention of rust in the galvanized steel messenger strands. Since rusting of these strands, once started would be very difficult to stop, it is essential that the cable be protected before signs of rust appear. Our engineering department has recommended that a protective paint be applied after the cable has been in service three years. We are about at that point with some of our cable, in fact, beyond it, and have noted no signs of rusting as yet. At one location, adjoining a very fine estate, the cable was painted with a green bronze at the time of the installation. This job has held up very well. At another location, under the stone archway already described, the cable was subject to seepage through the cinder railroad bed above. Here we experimented somewhat with protective coatings. On one part we tried brushing a thick coat of warm splicing compound, and the rest was coated with ordinary asphaltum paint. The compound apparently gives good protection; but it is extremely difficult to apply and the appearance of the job is far from neat. The asphaltum paint seems to fill the bill perfectly and will probably be used widely. A dull aluminum paint has also been recommended.

It is advisable to inspect all splices and terminations at least once a year to be sure there are no cracks or excessive weathering of the insulation. If there is time and manpower available, this inspection should be extended to the entire cable in order to spot any mechanical damage or incipient corrosion. If the cable at Chesapeake City is any criterion, there is little danger of moisture penetration if no mechanical damage has occurred.

Lightning Protection

Like any other cable, "SS" cable should be thoroughly protected against lightning. It is our practice to install lightning arresters at any point where the cable connects to open wire and maintain complete and frequent interconnection between sheath, lightning arrester grounds, and system neutral.

There are very few kinks or tricks to installing "SS" cable. A 1,000-ft. length of $1\frac{1}{2}$-in. pulling rope is kept on a reel for this special purpose. Of course, a swivel is essential between pulling rope and cable, and a good clean connection, free of any projections at the point where the swivel is attached. It has been found unnecessary to use running blocks when stringing the cable, except when pulling around corners, then a special pulley wheel arrangement is used. There is nothing in the handling of "SS" cable that cannot be quickly picked up by the average line crew.

What Factors Most Influence Future Water Heater Sales?

Will long charging hours increase sales of water heaters post war?

Which is electric water heating's leading competitor, gas or coal?

How much does it cost a family to heat water with the various fuels?

GREGORY L. REES,* Edison General Electric Appliance Co., Inc., Chicago, Ill.

ENGINEERS and sales people of utilities, and electric water-heater manufacturers usually view gas as their leading competition—as the opposition to be overcome if electric water heaters are to be widely used. This attitude is justified in many territories by the presence of a gas water-heater salesman at the scene of a prospective sales; then too, gas is the established fuel in many larger cities.

But on the basis of what fuel now has the business, coal is electricity's competition for water heating business. More than 10 million homes procure their hot water from coal-fired water heaters, or from furnace coils. But an even larger group, 14 million homes, have no water heating facilities of any kind. These figures, based on 1940 data, are for 35 million homes. Subtracting homes with coal heaters and with none at all there are about 10 million homes with gas, electric and oil heaters.

These figures distort the picture somewhat, because not all of the 14 million with no water heating are prospects for automatic heaters. That group includes homes without running water, those not wired and otherwise not qualified. Of the 8 million homes heating water with gas, most could use electric heaters. However, many of these in practice are "unavailable" for electric water heaters; disqualified by such conditions as inadequate charging periods, high service prices for electricity or the lack of proper electric wiring.

Table I
Water Heating Methods in Use —1940

	Dwellings
Electric	1,189,000
Gas	8,200,000
Coal and Wood	4,300,000
Oil	550,000
Indirect (furnace coil)	6,500,000
None	14,116,552
Total	34,855,552

* Manager, Range and Water Heater Sales Division.

Statistical tables presented in this article were compiled by the commercial research division, Edison General Electric Appliance Co., Inc.

Encouraging for the electric industry is the ever-improving pattern of charging hours, energy prices, and wiring policies. These changes all tend toward bringing a larger number of meters into the "favorable" zone. In 1935 less than 5 million electric meters had a "favorable" (1.2 cents per kw.-hr. or less) water heating rate. That number had grown to about 15 million by 1940.

It is probably true that at least 10 percent more meters have been placed on "favorable" rates since 1940. But that does not mean that the path of electric water heater sales progress will be a smooth one postwar. More important than actual service prices, as utility engineers know, is the period of the day during which the rate is in effect. In 1935 most of the meters having a special price for this service permitted its use less than 12 hours daily, while less than 5 percent made it available for 24 hours. By 1940 more than 50 percent of the electric meters had water heating on a special price 17 hours or more.

Most of the problem of procuring large volume water heating business is bound up in the charging-period policy of each utility. Ways must be found either with formal rate changes or by lower prices for water heating service to lengthen the charging hour period. The market for a 30-gallon automatic storage water heater is far greater than for the 40-gallon size. But without 17 hours charging the 30-gallon heater will not satisfactorily serve an average family.

Table II
Increase in Number of Homes with Favorable Water Heating Rate

Year	Domestic Meters	Meters with Rate Available*	Percent of Total
1935	20,649,111	4,750,000	23
1936	21,310,197	8,300,000	39
1937	21,979,371	9,650,000	44
1938	22,709,487	12,700,000	56
1939	23,523,819	13,645,000	58
1940	24,488,670	14,700,000	60
1945	28,436,657	.....	.....

* Covers meters with a rate of 1.2 cents per kw.-hr. or less.

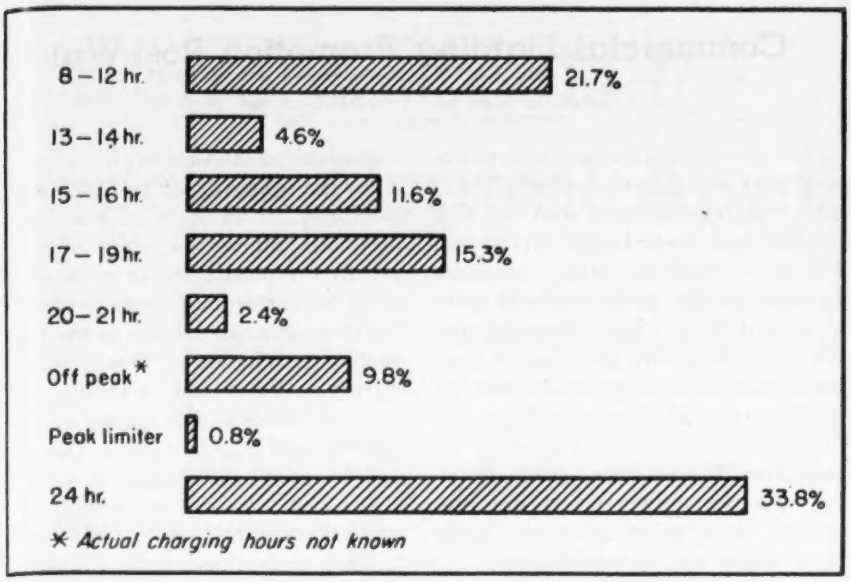
Here are a few facts that obtain when 18 hours or more are available as the charging period.

Automatic electric storage heaters cost less to buy than gas storage or instantaneous heaters.

Electric heaters have a considerably lower installation cost than gas where the building has adequate wiring.

Electric heaters can be installed any place where water can be piped. Flue requirements do not limit it to a specific area in the basement. This permits installation closer to the point of use. These facts benefit users of electric water heaters without regard for other inherent advantages of the electric heater.

Many of us forget that coal heater.



WATER HEATING CHARGING HOURS of electric utilities in 1940

or furnace coil operation costs money, as does the operation of an automatic storage heater. The cost of supplying hot water with a coal-fired water heater for a family of five, if the coal costs $9.00 a ton, is over $3.00 a month. While it may be somewhat less where a furnace coil is used, it still costs money for the B.t.u.'s that go into the domestic hot water. But the customer must care for his fire in a coal water heater; and he must use water as it comes from the faucet—hot—warm—cool—if he depends on a furnace coil.

Natural gas, at $0.70 per 1,000 cu. ft. is "competition." A family of five can get hot water from a storage heater with this fuel for $1.54 a month. That is infinitely better than the coal proposition. The utilities would have a darker outlook if they faced that rate in many places. Of the 28 million customers having electric meters, only 8 million have natural gas. That is less than one-third, and apart from the percentage, it leaves more than 20 million that natural gas does not reach.

Table III shows the operating costs for an average family with each of the types of fuel.

Where the electric service cost for water heating is not available for more than 17 hours daily, future sales expansion rests with larger heaters. The objection to promoting the sale of larger heaters is that the original purchase price becomes higher than for gas heaters. In 1941 almost one-half of the electric storage heaters sold were of the 30-gallon size. That size is sufficient for the one-bathroom home where the meter permits at least 17 hours charging. Slightly more than 20 percent of the heaters sold were 40 gallon capacity and another 20 percent were 50 gallon. Where electric companies do not have 17 hours or more charging period, the sale of heaters with more than 50 gallon capacity would overcome the rate limitation. This policy is not suggested as a sound promotional procedure for companies having long charging periods.

Merchandising

A survey of more than 200 electric utilities conducted in 1944 by this company showed that 94.5 percent of the utilities answering and that will merchandise appliances, will handle electric water heaters. That figure is slightly less than the figure for those merchandising water heaters in 1941. We take this to be evidence that the utilities look upon water heaters as becoming more self-sufficient in the hands of independent dealers. For example, in 1941 only 83.7 percent of these utilities merchandised electric refrigerators and an even smaller number, 79 percent, plan to sell them post-war. The newest wide-acceptance appliance, the home freezer was sold by 8.7 percent in 1941 and will be sold by 77.3 percent post-war. Since the survey was made, interest in home freezing has increased among both manufacturers and dealers and it is possible that a utility survey today would show that a smaller number will sponsor the sales of this appliance than had previously planned.

In the survey we asked 286 utility companies about their plans for installation allowances for electric water heaters. The question was answered by 242 companies, as shown

Table IV
What Appliances Will Utilities Merchandise?

	1941		194X	
	Number of Utilities	Percent of Total	Number of Utilities	Percent of Total
Total Number of Utilities Merchandising	184		181	
Ranges	180	97.8%	173	95.6%
Water Heaters	175	95.1	171	94.5
Refrigerators	154	83.7	143	79.0
Dishwashers	68	37.0	123	68.0
Clothes Dryers	13	7.0	105	58.0
Waste Exists	50	27.2	109	60.2
Clothes Washers	124	67.4	123	68.0
Ironers	122	66.3	118	65.2
Home Freezers	16	8.7	140	77.3

Table III
Comparative Costs of Heating Water for a Family of Five

Fuel	Cost Per Unit	No. units	B.t.u. Energy Rates	Average Monthly Water Heating Bill
Bottled Gas	$0.05 per lb. 0.25 per gal. 0.25 per therm. 5.00 per 100 lb. cylinder 7.20 per 150 lb. cylinder	20 gal.	1.9:1	$5.52
Natural Gas (1,000 B.t.u.)	$0.70 per 1,000 cu. ft.	2,206 cu. ft.	1.9:1	1.54
Manufactured Gas (540 B.t.u.)	$1.31 per 1,000 cu. ft.	4,085 cu. ft.	1.9:1	5.35
Mixed Gas (850 B.t.u.)	$1.00 per 1,000 cu. ft.	2,595 cu. ft.	1.9:1	2.60
Electricity (3,415 B.t.u.)	$0.01 per kw.-hr.	340 kw.-hr.		3.40
Oil	$0.06 per gal.	42 gal.	4.9:1	2.52
Coal	$9.00 per ton	726 lb.	8:1	3.27

Table V
What Policy on Water Heater Installation Allowance?

		Percent of Total
Utility Will Pay *Part* of Installation Cost	46	16.1
Utility Will Pay *All* of Installation Cost	15	5.2
No allowance on Installation Cost	143	50.0
Utility Uncertain on Post-War Policy	38	13.3
No Answer	44	15.4
	286	100.0

in accompanying Table V.

As the figures show, one-half of the companies will not participate in the cost of water heater installations. At first glance it may appear that only 50 percent of the utilities are interested in gaining water heater business. Actually the half which is not sharing installation costs includes all utility properties where competitive conditions, including combination electric-gas properties, place extreme limits on potential. Those combination companies do not pay gas installation costs either, except during limited sales promotion campaigns. Likewise, the gas competition does not pay installation costs in most of the large markets.

A conclusion from examination of the installation situation indicates that the electric industry is probably doing more than is the gas industry to encourage water heater installations.

A serious problem that faced the electric water heating business a few years ago, concerning standardization of equipment appears to be well on the way to a happy solution. The survey showed (Table VI) that only 15 percent of those answering are not ready to recommend the EEI—NEMA standards.

Table VI
Do Utilities Specify EEI-NEMA Standard Water Heaters?

		Percent of Total
Either in Use or Will be Required	198	69.2
Will Be Recommended	3	1.1
Do Not Recommend	43	15.0
Uncertain	16	5.6
No Answer	26	9.1
	286	100.0

Commercial Lighting Promotion Post-War

By E. E. ACKLAND,
*Canadian General Electric Co.**

We have had dimouts and power shortages which have compelled us to advise the customer to make do with smaller and fewer lamps, and it will take some work to bring customers back to pre-war levels, and still more to exceed them. Many electrical contractor-dealers have gone out of business, many new ones are starting up in business, and those that have survived the war period will need re-education. It seems reasonable, therefore, that the commercial lighting promotion department must be larger than before and better equipped.

Use should also be made of local I.E.S. members to assist in attaining objectives, and to provide technical information and assistance in training new staffs and in any lighting schools which may be held.

Schools should be held for dealers, contractors, jobbers, manufacturers, consulting engineers, architects and college students. We have held them pre-war with excellent results. The job will have to be done all over again.

I suggest that one of the most important features of any promotional plan is the necessity that all of us work to the same standards. It causes doubt on the customer's part and trouble between different groups of the electrical trade, if one man tells a customer that 15 foot-candles will do the job and another man says 25 foot-candles are needed. I suggest we follow the standards of the I.E.S. We must be uniform in our recommendations.

To assist dealers to participate profitably in the lighting program, jobbers and manufacturers should be urged to provide ample protection so that the dealer is encouraged to solicit business from the hundreds and hundreds of stores in the small community shopping centers.

It is realized that unless the utilities and large lamp and fixture manufacturers act quickly the country will be flooded by "carpet-bagger" fixture salesmen whose only object will be to sell as many fixtures as possible without any consideration for the lighting results achieved. This will inevitably result in dissatisfied, disillusioned and disappointed storekeepers, customers, and a "black eye" for the fluorescent store lighting idea.

The basic idea behind the "Nest Egg Plan" of the General Electric Co. is for the utility to sell and install immediately, or as soon as possible, a first-class fluorescent store lighting job in a typical store in each of its city's main shipping areas so that its lighting salesman can say to the prospective purchasers—"This job (referring to the job he is selling) will be comparable to the (name of well-lighted local store) store". Thus, he will be able to demonstrate visually to his customers all the benefits of a correctly-designed and installed store lighting system and at the same time have a potent weapon to defeat his "carpet-bagger" competitor.

The I.E.S. has an excellent new movie entitled "Now You Can See," and under the aegis of such an organization it is assured a respectful viewing. This should be a part of any utility promotional plan.

Use should also be made of manufacturers' promotional plans of which there are several excellent prepared ones available.

NEMA also has an excellent detailed plan and one feature of it, which is worthy of emphasis, is the greater and continuous use of direct mail. There are complete direct mailing pieces of excellent quality already prepared and available.

Give each man or woman in the promotion department a portfolio of "before" and "after" photos of good lighting jobs.

Set up a system whereby a true cost of lighting promotion can be charged against increased load. Plan to make a distinction between load-holding and load-building.

Get demonstration material that is available and other sales helps worked out ready to go.

Prepare to make voltage checks on all sizable fluorescent jobs. You will have a great many more satisfied customers, for fluorescent lighting requires 118 volts for the best performance.

Contact architects with material which will interest them.

Finally, lay your plans for the number of people you need and the course you will follow. It is none too soon to lay them now.

*Abstracted from address to Canadian Electrical Association.

Electronic Tools for Process Control Applications

An evaluation of where and in what manner electronics contributes to the measurement and control of process variables—Discusses elements required to measure and control non-electrical quantities by electrical methods—Adaptability for a.c. and d.c. signal

H. D. MIDDEL*, General Electric Co., Schenectady, N. Y.

ELECTRONICS gives to process control another medium which makes possible certain forms of control hitherto solved only theoretically. While it is not expected to revolutionize the industry it is expected to take its rightful place among other forms of control, i.e., pneumatic, hydraulic, and mechanical. Electronics is not imbued with any occult power nor does it provide a superior alternative to intelligent manual control on those applications where manual control has heretofore been the choice. However, certain automatic control installations may in some instances be improved upon by electronic means.

Electronics will be used, for example, in process applications where its inherent speed of response is a must, as in recording temperature of fast-moving billets or strip. It will be used where level and vibration preclude the use of galvanometer type potentiometers; in aircraft, shipboard or drop-forge applications. It will be used when small electrical signals are available as in pH, thermal conductivity and combustion gas measurements.

It is particularly well adapted for dealing with a.c. signals. Here it provides phase-responsive circuits which eliminate the wattmeter and a.c. galvanometer-type detectors. In this capacity it will find extensive application in a.c. measurement applications. It may change to a.c. certain measurements which were heretofore d.c. such as thermal conductivity and resistance temperature detector measurements.

*General Engineering Laboratory

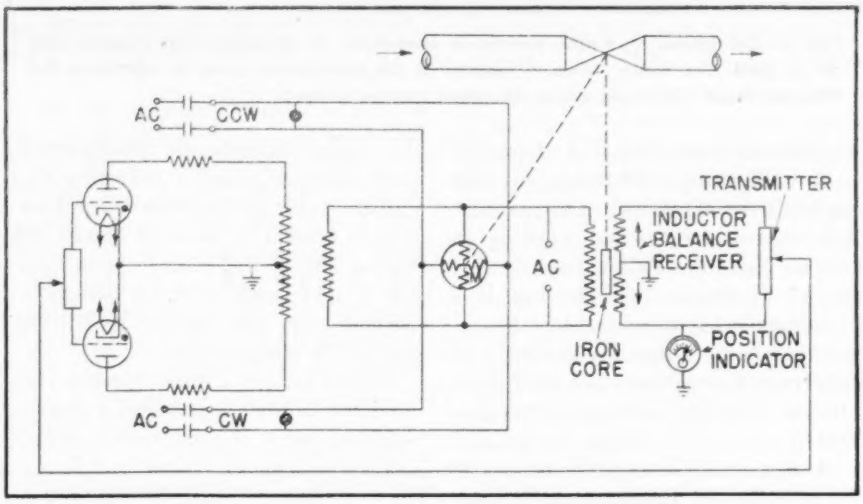


FIG. 1—Electronic potentiometer of the discontinuous type operates relays rather than the load itself. Stepless control provided by electronic tubes has been sacrificed for economy. Suitable for remote applications such as pre-set valve operations

Electronics will also find application in the control of electric furnaces and motor-operated valves to effect modulated control not possible with simple contactor systems. It will cooperate with pneumatic, hydraulic and mechanical instrument types to extend the ability of each.

This article will concern itself with demonstrating the influence of electronics on the measurement and control of variables common to most processes.

Primary Elements

Process variables may be measured either by inferential or direct methods. Although every variable can be resolved into some electrical quantity by the primary element, suffice it to say that the directness of certain measurements precludes that this will be done except in special cases.

Common denominator of all measurements of non-electrical quantities by electrical methods is the fact that the primary element will yield either a.c. or d.c. In the case of temperature, thermal conductivity, or pH the primary element is most likely to produce d.c. For other variables like pressure, flow, liquid level, electrical conductivity, color, etc., the output is likely to be a.c.

Requirements of a measuring circuit for use with these primary elements in general favor the potentiometer type. This choice is based largely on the accuracy requirements established by the industry.

Although negative or inverse feedback has done much to make the

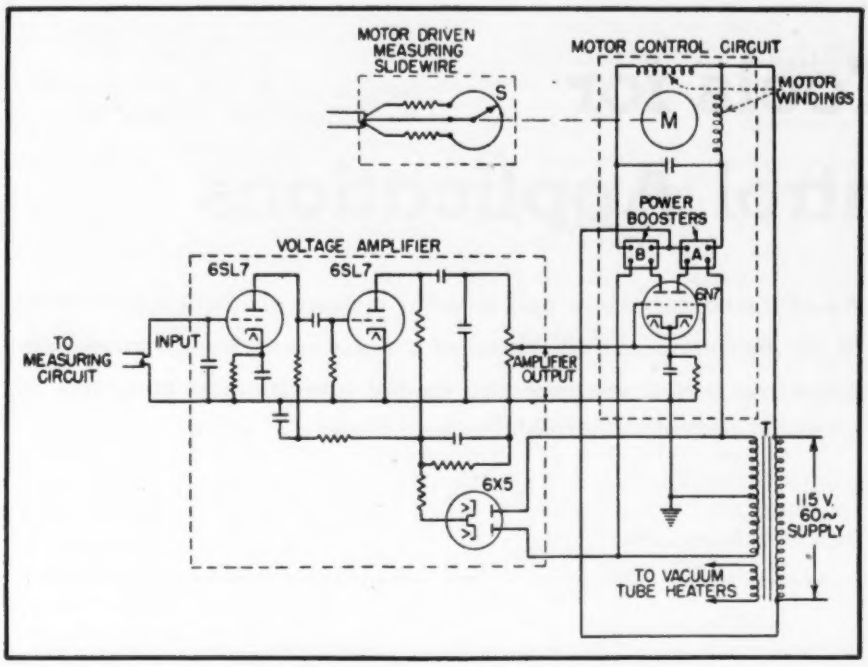


FIG. 2—Continuous type potentiometer is essentially an amplifier with a motor field as its load. The motor drives a resistor in the measuring circuit to rebalance the amplifier input. Either an a.c. or d.c. motor may be utilized.

amplifier a measuring tool of permanent calibration, electronic circuits are not used extensively for quantitative measurements and control in process industry. This is no reflection on the electronic engineer but is a situation brought about by the requirements of automatic control. In this respect, amplifiers are used more often as relays or unbalance detectors, that is, as a servo-system component.

A measuring circuit, to be useful for all forms of automatic control not only must perform the function of rebalancing itself in accordance with process variable changes, but also must be capable of initiating a series of operations of the process apparatus which will return the variable to its control setting.

Self-balancing Potentiometers

While there is a variety of electronic types of self-balancing potentiometers, they prepresent only two principles: First, those which feed back negatively a portion of the output to reduce continuously the input signal to a minimum in keeping with the sensitivity of the basic detector; and second, those which amplify the unbalance signal and control power flow to drive a rebalancing motor in such direction as to reduce the input signal to a minimum determined by the sensitivity of the system.

Photoelectric Potentiometer — For d.c. measurements the photoelectric potentiometer using a reflecting-type galvanometer and phototube combination is typical of the first class. The signal deflects the galvanometer causing a light beam to strike the photoelectric tube and thereby control the grid of the vacuum tube.

Output of such a potentiometer may have for its load a recorder, a relay, a solenoid valve, a small motor, a generator field, or a saturable reactor. It is recognized that this type of potentiometer characterized by high sensitivity and high gain exhibits a very limited control ability.

Electronic Potentiometers—In the second class of potentiometers are those used as unbalance detectors utilizing an electro-mechanical type of feedback to rebalance the input signal to a minimum in keeping with the over-all sensitivity of the system. This class of potentiometer is the most useful for automatic control applications and takes one of two forms, that is, continuous or discontinuous.

Step Control

This discontinuous type of potentiometer derives its name from the fact that the electronic output operates relays rather than the load itself, as shown. Smooth, stepless control provided by electronic tubes has been sacrificed here in favor of economy.

Whether or not amplifiers are used, the relay type is characterized by a fixed dead band, represented by twice the pick-up current for either relay. Whereas dead bands may be desirable to minimize hunting in some forms of automatic control, the fixed characteristic limits the application of this type. It is principally used for those remote applications of pre-set valve operations and remote positioning of a controller element in response to some manually adjustable transmitter.

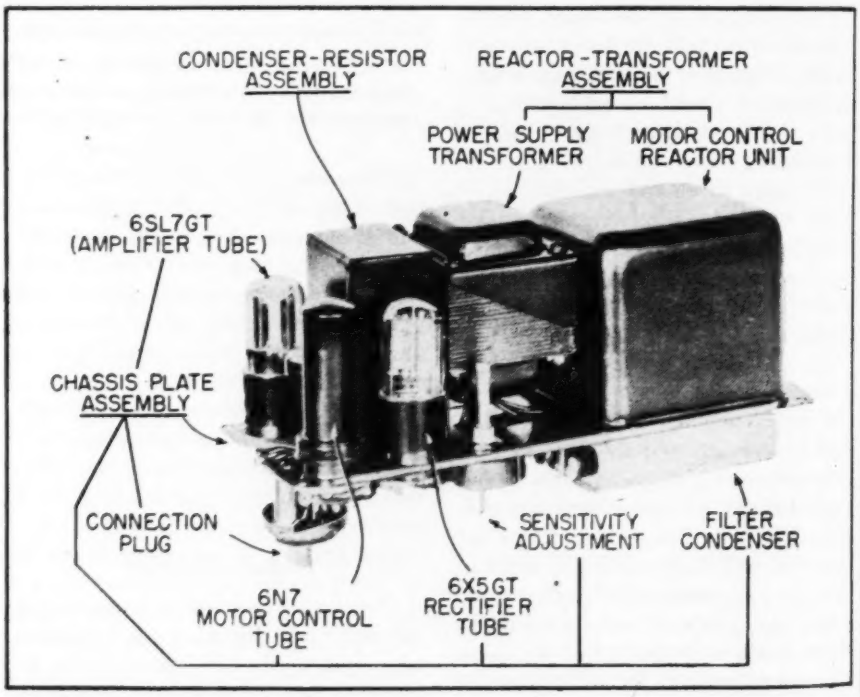


FIG. 3—Pyrotron unit, example of the continuous-type potentionmeter, responds to a temperature change of 0.025 deg. F. Voltage amplification by two stages is 2,500

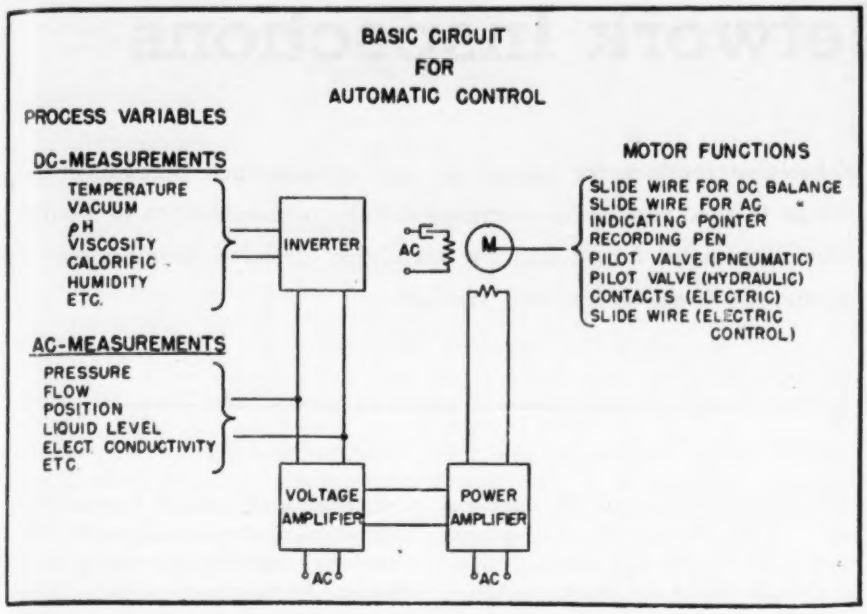


FIG. 4—Three electronic devices, the inverter, voltage amplifier and power amplifier make possible the measurement and control of most process variables

The relays may operate contactor panels in such manner that an unlimited amount of power may be controlled with a minimum of electronics.

Continuous Control

The continuous type of electronic self-balancing potentiometer is electronics' greatest contribution to process instrumentation. It is a versatile basic measuring circuit which, with minor adjustment and auxiliaries, is capable of measuring practically all process variables and instituting any type of control.

Basically, it is nothing more than an a.c. amplifier having a motor field for its load. The motor may be either alternating-current or direct-current. Its primary function is to drive a resistor, reactor, or capacitor in the measuring circuit to rebalance the input to the amplifier. In the case of an a.c. motor, one field of the motor is supplied directly from the line; in the d.c. types, the line alternating current is applied to two plates of the output tube. In each case the alternating current serves as a reference to determine the proper direction of rotation.

A typical example of the a.c. electronic potentiometer is the Pyrotron which was developed primarily for use with a platinum resistance temperature detector for temperature instrumentation applications. Sensitivity of this system is such that the motor will respond to a temperature change of 0.025 deg. F.

In the amplifier unit (Fig. 3) the two stages of voltage amplification of the 6SL7GT are 50 per section, or 2,500. The motor will respond to an input voltage of 0.0004. On a pressure detector this represents about 0.05 mil of motion. For a longer-stroke telemeter like a flowmeter transmitter, this may be equivalent to 0.2 mil of motion. With transformer input, the motor sensitivity becomes 0.00003 volt.

Such an electronic potentiometer is extremely flexible and is useful for a wide variety of a.c. instrumentation applications, such as temperature, pressure, flow, liquid level, position, etc.

Output or balancing motor has approximately 140 oz.-in. of torque, which is adequate for performing a number of simultaneous functions, such as driving an instrument pointer, a recording pen, a pneumatic, hydraulic, mechanical or electric controller. Such flexibility is essential to fill the wide variety of instrumentation applications. The limit of flexibility of this system is the fact that it is not by itself applicable to d.c. measurements.

Galvanometer Use Limited

In d.c. measurement the galvanometer is the cornerstone upon which electrical measurements and automatic control of the process industry was founded. The galvanometer was and is the foremost detector of d.c. and as such has always been an integral part of a potentiometer.

However, today we find the picture changing. Electronic equipment incorporating galvanometers is limited in its application by its speed of response and its sensitivity to level and vibration. Since a.c. electronic amplifiers are simpler, more practical and stable than the d.c. direct-coupled variety, it is logical that means should be developed to invert the d.c. signal and eliminate the galvanometer.

There are, to date, a variety of inverter devices, none of which has the inherent sensitivity or accuracy of the galvanometer, but is satisfactory for the majority of process-measurement applications. They take the form of motor-driven choppers, vibrators, carbon piles, reactors, and non-linear resistors. Inversion, in general, takes place at line frequency.

An inverter coupled with the a.c. amplifier and motor combination of the Pyrotron type would thus become a means for measuring and controlling d.c. process variables, such as temperature, pH, vacuum, etc.

The accompanying chart illustrates graphically how, through the use of three electronic devices it becomes possible to measure and control the majority of the process variables. In addition to the use of the basic measuring circuit for measuring single quantities it may also be used for complex quantities. This is so because it lends itself to addition, subtraction, multiplication, and division. In this manner the B.t.u. of a heat exchanger may be obtained.

Control

The continuous potentiometer, when serving as a recorder, may simultaneously serve the function of operating a pneumatic controller having forward and reverse acting, throttling range and automatic reset rate adjustments. To date, this combination for a pyrometer control problem has not been equalled in simplicity and flexibility. The pneumatic controller has been teamed up with the electronic potentiometer to control pneumatic valves. In some cases the output loading air pressure is used to modify a resistor or reactor transmitter in an electronic servo system to drive a motor operated valve. This has been done where distance, compressibility, leaks, corrosion or viscosity made electric valve operators the choice.

Handling Network Inspections

Scheduled routines for inspection and maintenance procedure contribute to good service by assigning definite responsibilities to distribution department forces and by specifying detailed requirements of equipment examination and records

TO SYSTEMATIZE and insure continuity of supervision over the alternating current network of the Worcester County Electric Co., Worcester, Mass., the distribution division has established comprehensive instructions for inspection and maintenance of this equipment. While these instructions naturally apply primarily to a specific geographical layout and in detail refer to local points lacking outside significance, their general assignment of responsibility and procedure are of broader interest, including the makeup of certain report forms employed. The installation is confined to the downtown area, extending north and south for a distance of roughly a mile along the principal business thoroughfare, with lateral connections at various points and the usual 120—208-volt low tension service from about 30 transformer vaults supplied by 13.2-kv. feeders.

Under the jurisdiction of the general superintendent and the assistant superintendent of distribution, a technical assistant (special tests and records) becomes responsible for the proper operation and maintenance of all a.c. network protectors and for the general condition of all network installations. A maintenance supervisor is in charge of the operation and maintenance of network transformers and for necessary cleaning and repairs to network installations when reported to him. This supervisor is required, when requested, to furnish extra help to the technical assistant in connection with the foregoing special tests and records to facilitate operation and maintenance. The company's meter department designates a network inspector to aid the technical assistant and report to him the first three weekdays of each week.

WORCESTER COUNTY ELECTRIC CO.
DISTRIBUTION DIVISION

Vault Name_____ Cable No._____ Date_____

Protector Type_____ Protector No._____

Date	Time	As Found	Automatic Operation	Substa. Operation	Test Operation	Work Operation: Name	Work Operation: Counter Reading	As Left	Inspected By	Remarks

5-IN. BY 8-IN. WALL CARD kept in network vaults to record condition of protector and counter operations. Readings also recorded in the office file

WORCESTER COUNTY ELECTRIC CO.
WORCESTER DISTRIBUTION DIVISION
LOAD NETWORK TRANSFORMERS

Location	Vault No.	Feeder	Amperes A	Amperes B	Amperes C	Date	Time
Telephone Bldg.	1	7 H.T.					
" "	1	5 H.T.					
Chase Court	2	7 H.T.					
" "	2	8 H.T.					
" "	2	6 H.T.					
State Mutual	3	8 H.T.					
" "	3	5 H.T.					
Poli Theatre	4	7 H.T.					

10⅞-IN. BY 8⅜-IN. FORM for recording the ampere readings each month on the secondary phase wires of each network vault

Inspection Routines

Each Monday the network inspector visits each network installation. Where the transformer and protector are in separate compartments, reached through manhole covers, the transformer compartment is visited only on the first Monday of each month. Any undesirable conditions of apparatus or installation are reported to the technical assistant, whose duty is to take remedial action as soon as possible. Any required cleaning, pumping and transformer maintenance is reported to the maintenance supervisor, and cable work to the general line foreman.

On each visit the network inspector examines the protector, reads the operation counter and records it on a wall card provided in each vault. This reading is also recorded in a permanent record file in the technical assistant's office. Any untidy appearance of the installation is reported and also any excess water in network manholes.

On the first inspection trip each month every network transformer is examined, checking the oil level in the transformer and the grounding switch, examining the installation for oil leaks and the pothead for com-

WORCESTER COUNTY ELECTRIC CO.
DISTRIBUTION DIVISION
NETWORK RELAY RECORD

Make_____ Type_____ Date Purchased _____ Cost $_____ W.C.E. Co. No.____

Kind of Relay_____ Mfr's Information_____ Serial No._____

Installed at	Date Installed	H.T. Fdr.	Protector No.	TEST RESULTS As Installed Volts to Close	As Installed Amps. Rev. Ct.	As Removed Volts to Close	As Removed Amps. Rev. Ct.	Tested by	Date Tested	Remarks

NETWORK RELAY record card, provides case history for the relay unit

pound leaks. The position and state of the locking device on the grounding switch is checked, making sure that it is in the operating or "Transformer" position and locked. The temperature indicator on the transformer is read and re-set. The inspector also reads with a tong type instrument the amperes in each wire on the secondary side of each transformer, recording the reading, day and time on a form provided. This form being in size 10¾ in. by 8¾ in.

Protectors Inspected

Each protector is given a thorough mechanical inspection three times a year, with cleaning, necessary repairs and adjustments. The relay disk is checked for free operation by disconnecting the closing and tripping mechanisms, opening the protector, disconnecting the potential elements of each relay, turning the disk of each relay to the tripping position and permitting the disk to turn to the closing position under spring tension. The relay is changed if the disk does not, when adjusted, rotate smoothly under spring tension. Submersible type protectors are not opened at other times unless necessary. Great care is taken in opening these not to disturb or damage door sealing gaskets. When necessary, doors are pried at the latches only and never between door and case. Gaskets are kept well greased and promptly replaced when broken. In sealing doors the clamps are set up slightly more than finger tight, then tightened with a socket wrench beginning at the middle of the door and working toward the ends on alternate sides, the end clamps being tightened last. This process is repeated for a final check-up. Special weekly mechanical tests are given the pumping equipment where required to drain a sump.

Relays and network protectors are tested yearly by the network inspector during a mechanical inspection. Each relay is removed from the protector and replaced with a relay which has just been tested and set for that particular location. It is planned to keep at least one spare relay of each kind and make at the meter department headquarters. This testing is done at the latter place, with cleaning and adjustment to the specified setting and location as defined by the technical assistant. Ordinarily such relays are set to open the protector on less than 5-amp. reverse current and to close it on a potential difference of 2 volts. The technical assistant also specifies settings required at points where elevators or other conditions require them.

All network protectors are given a yearly operation test at the time of the mechanical inspection. Closing and tripping mechanisms are disconnected from their regular sources of supply, and by rheostat and voltmeter applying to each the minimum operating potential specified by the maker. At least two successful operations of each mechanism are required at the specified voltage, before or after repairs or adjustments. New protectors are acceptance-tested at a company shop where facilities are available to check for mechanical defects and proper relay operation. Submersible protectors new or used are given an internal air test in the shop of about 10 psi.. and must hold this pressure 5 min. without appreciable loss.

Each year the technical assistant is

THE WORCESTER ELECTRIC LIGHT CO. -- DISTRIBUTION DIVISION

Network Protector Apparatus Record

Style_____ Type_____ Capacity_____ MFCo._____ Serial_____

Bus Contact Resistance -- DC Millivolt Drop

	A	B	C	D	E	F	TOTAL
PERMISSIBLE DROP AT AMP.							
DROP AT AMP.							
A BUS DROP AS LEFT AT AMP.							
DROP AT AMP.							
B BUS DROP AS LEFT AT AMP.							
DROP AT AMP.							
C BUS DROP AS LEFT AT							

PROTECTOR INSPECTION

Mechanical_____
Hand Oper. Lever_____
Toggle Adj.-Shunt Trip_____
Closing Mechanism_____
Toggle. Adj.Aux. Switch_____
Min. Shunt Trip Oper. Voltage_____
Normal Motor Running Current_____
Initial Motor Starting Current_____

Veeder Counter_____
Adj. of Bkr. Contact Blocks_____
Motor Sw. Make & Break Adj._____
Close in Voltage_____
Operation with Relays_____
Ring Out Wiring_____
High Potential Test_____

REMARKS_____

Tested By_____ Date_____

Installed At_____ Cable No. _____ Date_____

Reason Removed_____ Date_____

Reinstalled At_____ Cable No. _____ Date_____

Date Purchased_____ Cost_____

Mfrs. Information_____

NETWORK PROTECTOR APPARATUS record sheet

responsible for measuring the total peak load on the a.c. secondary network three or four working days before Dec. 25.

Use of Records

Records of all network transformers are kept by the maintenance supervisor in the same manner as for other 13.2-kv. transformer installations. The technical assistant (special tests and records) is responsible for all other records of network installations. For each network protector an apparatus record and an operation record are maintained on 8½-in. by 11-in. loose leaf sheets filed in the office of the technical assistant. The first is a physical record of the protector from acquisition to retirement. This includes acceptance test data, notably on voltage drops, mechanical performance check-up, dates of installation and removal and the filing number of any makers' diagrams or instruction books. The operation record shows all operations and inspections of a network protector at a particular location. Entries are made by the inspector after each weekly visit and at such other times as the counter may be read or inspections made. A new sheet is started whenever a protector is installed in a new location, or when the sheet already in use is full. A card similar to the operation record is kept at each location for recording counter readings.

Each protector relay has a 5-in. by 7-in. record card, started when the relay is received, entries being made by the inspector each time that a relay is installed, removed or inspected. Relays are given the company's numbers with a prefixing letter indicating the make and kind of relay as follows: (A) G.E. phasing relay; (B) G.E. master relay; (C) Westinghouse phasing relay; (D) Westinghouse master relay. The "As Installed" column under "Test Results" indicates the setting of the relay at the time it was installed at the location given on the same line under "Installed At", and the "As Removed" column indicates the condition in which it was found after one year of service at the location.

The ampere readings taken monthly are recorded in duplicate, one copy being transmitted to the superintendent of distribution for further remanding to the engineering department of the New England Power Service Co. The other is filed by the technical assistant. Annual ampere and kilowatt load readings are recorded and filed in the last named staff member's office.

When any disturbance occurs on the system which involves the a.c. network or the feeders supplying it, the technical assistant makes a detailed report in an unusual trouble book of all resulting operations of network apparatus. This is in addition to all other reports of the disturbance which are regularly entered in this book. Reports of transformer temperature indicator readings and other matters of interest to the maintenance supervisor are given him by the technical assistant (special tests and records) as soon as received.

WORCESTER COUNTY ELECTRIC CO.
DISTRIBUTION DIVISION
NETWORK PROTECTOR OPERATION RECORD

LOCATION_____ PROTECTOR TYPE_____ PROTECTOR NO._____

Date	Time	Counter Reading Found	Counter Reading Left	OPERATIONS Auto	OPERATIONS Sub-Sta.	OPERATIONS Test	OPERATIONS Work	Reported By	REMARKS (State reason why man was there)

PERIODIC INSPECTIONS

Date	General Condition	Relay Charge	Inspector	REMARKS (List necessary repairs if any)	Repairs Complete	By

NETWORK PROTECTOR OPERATION record sheet

Voltage Ratings for Industrial Systems

At the midwinter A.I.E.E. meeting the committee on industrial power applications arranged a conference for the discussion of system and apparatus voltage ratings from the standpoint of the industrial user and at the same time provide an opportunity for the presentation of the view points of the utilities and the manufacturers.

A joint EEI-NEMA committee on preferred voltage ratings is studying the problem. A subcommittee is collecting material to be used in an advisory manner to form a basis for standardization. According to the advisory committee, the problem has three major parts: (1) Definition of nominal voltage; (2) establish voltage spread for each nominal voltage; (3) using the spread as a guide, what is to be done for rating of the equipment?

From a consumer's viewpoint in the steel industry the problem was considered by working from the motor and equipment back to the bus. Motors have a specific voltage rating, for example 220 and 440 volts, and will operate satisfactorily at plus or minus 10 percent of rated voltage and plus or minus 5 percent of rated frequency. An examination of load swings in several mills indicated that with suitable motors, applications of flywheels and motor-generator sets the voltage variation was not much over 5 percent. Recommendations were made: (1) 220, 440 and 6,600 volts be standard for equipment and 115 volts for lamps; (2) 6,900 volts be maintained at the substation bus; (3) 2,300, 4,600 and 6,900 volts be standard for distribution.

Other items for consideration will be outlined in a subsequent issue of ELECTRICAL WORLD.

War Effect on Output

Behavior of curve of weekly output increases from year to year tells story of electric utilities' response to demands of war

BEHAVIOR of our national economy under conditions of war is clearly reflected in the curve of electricity output increases for the years 1939-1945. This observation derives from examination of the rates of increase in weekly outputs of energy over outputs for corresponding weeks in the previous year.

Early in January, 1939, the output curve spurted upward from the low point caused by the Christmas holidays. For the remainder of the year the curve maintained a fairly steady course, except for May and September. An upward trend starting in May indicated the imminence of war in Europe. In September war had become an actuality with Germany moving into Poland, and the output increase moved sharply upward.

Throughout 1940 there was a continual slowing up of rate of output increase, even though a gain of 11.2 percent was registered over 1939. Low point was reached in the early fall (6.8 percent) when a slow upward trend began. This trend accelerated in the early months of 1941. Except for a drop in April, the curve held a relatively even course in spring and summer. The high point was reached in September (19.5 percent).

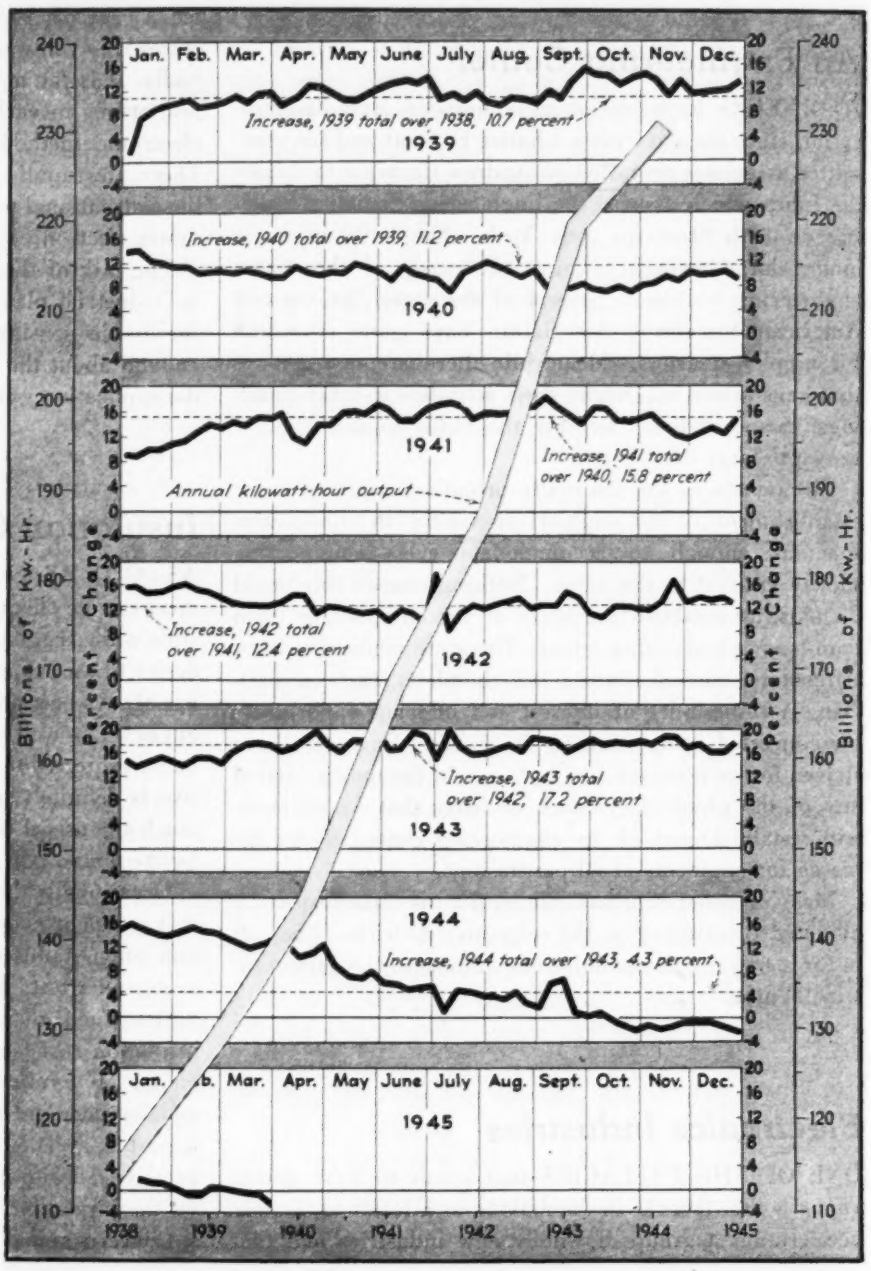
In 1940 and 1941, American industry was in the process of converting from a peace to a war economy. Thus, in 1941 the annual output increase rose to 15.8 percent.

Although plant conversion moved along at a much faster pace in 1942, the annual output increase was not as startling as in 1941; amounted to only a 12.4 percent gain over the previous year. In this year, approximately 5,000,000 kw. of new generating capacity were placed in service.

The peak in rate of output increase was reached in 1943. With plants completely geared for total war production, industry worked its electrical reserves longer and harder than in any previous year. This was clearly evidenced in the 17.2 percent annual output increase over 1942 along the line of which the curve of weekly increases clings very closely.

Early in 1944 the weekly output curve began to decline, indicating that industry had reached a plateau of production; it also indicated that industry expected an early victory in Europe. Toward December the curve hit the low of —2.6 percent. With the start of von Rundstedt's offensive late in December, the curve began an upward climb, seen in the 1.7 percent for the week of January 13, 1945.

However, toward the end of January, 1945, the curve began to decline again and, by mid-February, started an upward climb which later in March was reversed.


Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
Increase, 1939 total over 1938, 10.7 percent
1939
Increase, 1940 total over 1939, 11.2 percent
1940
1941
Increase, 1941 total over 1940, 15.8 percent
Annual kilowatt-hour output
Increase, 1942 total over 1941, 12.4 percent
1942
Increase, 1943 total over 1942, 17.2 percent
1943
1944
Increase, 1944 total over 1943, 4.3 percent
1945
Billions of Kw.-Hr.
Percent Change
1938 1939 1940 1941 1942 1943 1944 1945

Editorials

S. B. WILLIAMS, *Editor*

An Engineering Center

ENGINEERS have increased in numbers and diversification since the days when Charles F. Scott and his committee associates prevailed on Andrew Carnegie to donate the funds which assured the Engineering Societies Building on 39th Street in New York. The building is no longer large enough to meet the needs of the major engineering societies. Several of them and the cognate American Standards Association have gone elsewhere for ampler quarters. Meanwhile there are new groups that have arisen and begun their activities in other buildings. Some of these, notably the radio engineers, have grown to large dimensions.

Circumstances are unusually propitious right now for establishment of an engineering center in dimensions spacious enough to accommodate every engineering society entitled to the name. Nothing conceivable could do more to establish the unity of the engineering front than having just such a center. There are medical centers, art centers, musical centers, law chambers, each exemplifying a community of interest and offering opportunity for concerted recognition by the public. Engineers have striven for such recognition but none of the moves carried any of the physical evidence of unity that would come with establishment of an engineering center to be the mecca for engineers of all persuasions.

Mass membership has the spirit as manifested by affiliated functioning in the respective districts. The call is for a national community responding to the same centripetal urge.

Electronics Industries

ONE OF THE FALLACIES that seems to have gotten vogue is that there is in the making as a result of the war acceleration a group of wholly new industries and that one of these is the electronic industry. Admittedly there is a myriad of new businesses that have sprung up to make electronic forms of equipment, and meanwhile many of the previously existing ones likewise expanded their activities several-fold. They are all industries making electronic things and collectively they can constitute an electronics industry viewed from the standpoint of a manufacturing identity.

But from the standpoint of distinct entities in the field of industrial-social performance electronics is no more an industry than is measurement or control or carrier currents. Certainly it is not an electronic industry in the sense that automobiles, transportation, aviation, utilities and food are industries. Industrial electronics is a penetrating and percolating art and holds neither threat nor promise at the moment of supplanting any prior art on a wholesale scale.

That very fact is what makes the impetus of industrial electronics a problem for every other industry. It is not often a case of A-to-Z change-over; where there are such places they will want some full-fledged electronic engineers badly. It is far more a matter of discriminating study to find stages in each industrial process or function where electronic methods can do a peculiarly favorable job. There are rapidly being found just such instances where the conventional way of doing something has to bow to the newer electronic way.

The task of the electrical 60-cycle engineer whether in an industrial plant or in a utility system is to acquire a facility in sensing those places and in finding out just enough about the electronic mysteries to be able to keep the application working effectively once it has been chosen.

Insulation Condition

AS SOON AS the war loads relax enough so that equipment can be checked more thoroughly than has been possible while the loads were so commanding there will be a desire to ascertain the condition of insulation. Insulation has always been the *sine qua non* of the electrical industry but never so well recognized as in recent days while it was being subjected to sustained high temperature. The incentive is definitely present as never before to find out how much the useful life of the insulation has been shortened by the abuse.

Occasionally the consequences are visually manifest but that is a poor check because practically pulverized insulation often stands up mysteriously well in operation, and even under test. There are indications to be obtained by measurement of power factor, of leakage current and of insulation resistance but these need to be analyzed on a comparative rather than an absolute basis and corrections usually must be applied for humidity and temperature departures. They afford information as to drift or progressive deterioration without imposing any further stress on the insulation.

Concern about used insulation is about its remaining

ability to withstand voltage stress without puncture. The natural move is to apply voltage in some form to find out whether the material will stand normal working voltage plus a reasonable margin. The argument and the uncertainty is largely whether the "reasonable margin" may not be exceeded under abnormal operating conditions or whether the very application of too generous a voltage stress may not have created an incipient weakness.

That argument will go on and there will be divergent schools of thought about the techniques until someone devises a convincing meter that tells quite precisely how much deterioration there was before and after such tests. Having such a meter the over-voltage tests will be unnecessary. Meter number two will tell quite precisely the spot where the deterioration is the worst.

It is understood that alternator-winding-inspectors are dreaming of a pair of meters like that but it is also understood that their dreams are not likely to be realized. Thus whenever there is fear that important insulation has been degraded there will be as many different tests as there is time and justification for. Justification is at low level for some who live pretty nicely by relying on frequent and painstaking inspection of little details that may be overlooked if all the focus is on the testing procedures.

No Black Market in Kilowatt-Hours

TWO AND A HALF POUNDS showed on the butcher's scale.

"That'll be a dollar," he said.

"What?" the customer's voice rose, "Forty cents a pound for salt pork? And solid fat, too, not a streak of lean in it! Put it back in the case. We'll live on noodles."

As a good citizen, the customer should have reported the butcher as a black marketeer. But he didn't. He just wiped out of his mind two visions, one of a pot of beans with a succulently jellied chunk of pork nestled in the center and the other of crisply fried golden-brown slices contrasting with the whiteness of milk gravy.

Has anyone ever heard of black market operations in electric service? Of kilowatt-hours at one price yesterday and twice as much today?

The idea is absurd, of course. There is no rationing of electricity, no short supply from which those willing to pay boosted prices can get what they want while others go without. And besides, the prices of electric service are fixed by governmental authority. Well, so are the prices for salt pork and salami. There is a black market in meat and the butcher can get away with it. But if electricity were rationed the power company couldn't get away with any black market stuff.

There is, literally, no way for a power company to indulge in such operations; its prices can't be changed arbitrarily because, quite apart from governmental control, the mechanics of accounting alone would prevent any price juggling. The meters that register energy usage are precision devices far more accurate than the scales of any butcher or grocer. There is no way for a black market in kilowatt-hours to exist. Maybe it would be a good idea for utilities to point out these things to the public now that everyone is conscious of the evils of price control evasion as they appear in such manifestations as salt pork at forty cents a pound.

The Laundry Comes Up from the Basement

APPEARS that the home laundry is to move up higher on the social scale. Anyway it's to be brought up out of the basement and installed on a level more convenient for working; maybe even in a guest room because it's on that floor that bed sheets, pillow cases, towels, shirts and other articles for the *blanchissage* naturally accumulate. That's the pleasant scene painted by our zealous and enthusiastic friends who promote laundry appliances.

The reason for this improvement in the social tone of the home laundry is the agreeable facility with which electricity lends itself to automatic operations, the same useful attribute that so increases industrial production. There's the automatic washer, the automatic drier and the nearly automatic ironer, housing themselves in sleek and sightly cabinets and conspiring together to abolish sloppiness underfoot, clothes lines overhead and all the other unpleasant and fatiguing characteristics of wash day.

Now range the electric water heater along-side these appliances and one can see how the home laundry rounds out the overall picture of post-war residential load building.

You Can Help

Paper is a No. 1 war material shortage—because over 700,000 different *war* items are wrapped. packed, labelled, tagged, or made from paper or container board. The Pacific war, when it speeds up, will require stupendous amounts of paper and board since double and triple packing are required for protection against weather, insects, etc.

So please—

1. Share this magazine with your associates. Because of the paper shortage, the number of copies is limited.

2. Organize for a continuous drive in your office and plan to collect waste paper of any kind to put into paper salvage. Clean out old files, dead correspondence, obsolete records, useless display materials, cartons, etc.

Aid the war effort — speed victory —

DO THIS EXTRA BIT TO HELP!

WASHINGTON COMMENT

By R. N. LARKIN, Washington Correspondent

Brownout to Join Curfew in Discard

THE BROWNOUT apparently will be discarded on or immediately after V-E day. The door to this possibility was flung wide open by former war mobilizer James F. Byrnes, who said the brownout should be withdrawn at that time and, at this writing, it has not been closed by his successor, Fred M. Vinson.

Its passing will bring no complaints from the electric power industry, for the brownout was estimated to cost more than $60,000,000 a year gross, in lost revenue to electric suppliers affected by it. It entails, in addition, a certain amount of inconvenience and even trouble for electric suppliers, despite the fact that the Office of War Utilities drew order U-9 so as to minimize these troubles.

Coal Shortage Doubts

It is not the brownout's demise but the manner of its passing which causes the eyebrows to be raised. The brownout was invoked, according to Byrnes, and the President, as well, because there existed a coal shortage of major proportions. In view of this undisputed assertion, the contention that it can be done away with when the Germans cease fighting carries the unmistakable inference that no coal shortage sufficiently serious to warrant mandatory savings will exist on Germany's defeat.

This makes intriguing reading to householders who are prohibited now from obtaining more than 80 percent of their normal space-heating needs. Early last week, the Solid Fuels Administration for War, whose duty it is to oversee the nation's coal supply, said very bluntly that such was distinctly not the case.

Byrnes Unconvinced?

It may be that Byrnes was convinced that the brownout could not save enough coal to warrant its existence, and this is a question which can be argued without end. An official report on the first months' operations under the brownout, however, is expected to demonstrate that savings at an annual rate of more than the 2,000,000 tons originally expected from the brownout were achieved. Byrnes could have checked this so easily that it is difficult to believe he planned to end the brownout because it saved no coal.

Cutbacks

It is equally difficult to believe that the coal shortage will automatically stop when the Germans stop fighting. SFAW says it would take cutbacks in war production of 40 to 50 percent—and promptly after V-E Day—to clear up the coal shortage. Cutbacks of these proportions just are not in the woods, even under the most optimistic interpretation of last week's spate of reconversion discussion by Byrnes and WPB Chairman Krug.

SFAW adds that it bases its estimates of requirements for bituminous coal on the prospective demands of three major consumers—utilities, rails and steel. OWU anticipates no substantial decline in coal consumption by utilities after V-E Day, and what decline there is will be pretty well cancelled if war time is repealed. The redeployment of our armed forces to face Japan suggests no let-up in railroad demands for coal.

Hair-Shirt Recipe

The promise that a year after V-E Day will see not only war production sufficient to overwhelm Japan but civilian production as well on a level equal to that we enjoyed before the war, indicates either that steel's demands for coal will continue apace or that those bright new automobiles are going to be made of beaverboard. If the system which has enabled SFAW successfully to forecast coal requirements in the past now indicates continued heavy requirements after V-E Day, what's become of the coal shortage? At SFAW, at least, the suspicion persists that the shortage will still be around some time after V-E day.

Ever since Byrnes began disrupting normal civilian life by banning conventions and horseracing, turning out the lights and closing public places at midnight, the charge has widely been heard that it is all part of a "hair-shirt-for-civilians" campaign engineered by Maj. Gen. Lucius D. Clay, Byrnes' second in command and high priest of the cult.

2,000,000 Tons Saved

But Byrnes, the President and OWU insisted the brownout was a coal conservation measure. The electric power industry accepted it and helped make it work with 99 percent efficiency on that basis. The brownout has been demonstrated to be a successful conservation measure with the ability to save about 6 percent of the 30,000,000-ton coal deficiency which Byrnes said faced the country. It has had none of the ridiculous aspects of the curfew, roundly condemned by many officials in Washington as nothing short of a major blunder in execution if not in conception.

Now Byrnes, shortly after Washington's anti-hair-shirt brigade claimed credit for having Gen. Clay and his hair-shirt philosophy kicked upstairs, lumps the brownout with the curfew, the horse race ban and all the rest as something of so transitory a nature that it can be junked on V-E Day. By this classification, and by the absence of any specific showing indicating that the coal crisis which existed in January will no longer exist on V-E Day, Byrnes indicates that he may really have considered the brownout to be hair-shirt stuff when he sold it as a coal saving measure.

Utter Misinterpretation

By issuing a report in which he described the brownout as necessary "to reduce electricity used in advertising at night," an eight-word description which is wholly incorrect on three points, Byrnes gives the impression that he knew little and cared less about a fiat which affected millions of people and cost millions of dollars.

NEWS OF THE WEEK

Aluminum Shortage Made Canadian Aid Imperative

Vice-Chairman Batt of WPB Tells Senate Committee Every Hydro Installation in Northwest Which Would Aid Aluminum Output Was Made—Shipshaw Project Was Financed to Hurry Production

Every hydroelectric power project which the Interior Department believed could be installed in the Pacific Northwest in time to benefit the U. S. aluminum program was installed and an additional 150,000 kw. were installed beyond the amount seen possible by the Interior Department WPB Vice-Chairman William L. Batt told the Senate Small Business Committee this week.

Batt's testimony came as the Committee, headed by Sen. James Murray, Montana Democrat and an ardent New Deal supporter, opened an investigation of U. S. financing of the Shipshaw Power and Aluminum development on Quebec's Saguenay River. Public power exponents have been seeking the investigation for more than two years, charging that public power installations in the northwest were sidetracked while the Canadian project moved ahead with high priorities.

Batt submitted a table showing public power installations throughout the country proposed for the aluminum program by Interior Under Secretary Abe Fortas for 1941, 1942 and 1943, and comparing Fortas' figures with actual installations. The latter figure exceeded Fortas' program by 286,000 kw.

Describing the birth, early in 1941, and growth of the nation's aluminum program, Batt told the committee:

"We needed vast quantities of aluminum, and we needed it desperately soon. We were buying time, then, and any step and every step that would produce aluminum quickly was believed to be amply justified."

The United States, through subsidiaries of the Reconstruction Finance Corporation, advanced about $68,000,000 interest free to Canada for development of the Shipshaw hydro project, taking repayment in aluminum.

The first Shipshaw loan grew out of the need for an additional 100,000,000 pounds of aluminum after a stiff increase in the U. W. program, Batt declared. No possibility of increasing American production within stipulated time limits existed, but the capacity was offered by Canada. Had no agreement been made with Canada, a power shortage in the Dominion would have cut off Canadian energy exports which were then supplying the Alcoa Plant at Massena, N. Y., thus reducing the U. S. program, Batt said.

Canadian negotiations, Batt added, were carried out under the Hyde Park agreement between the President and the Canadian Prime Minister, which provided in part that "Each country should provide the other with the defense article which it is best able to produce, and above all, produce quickly . . . ."

Between January and May, 1941, Batt went on, aluminum requirements were quadrupled, rising from 25,000,000 pounds monthly to 100,000,000 pounds.

Batt denied that preference was given to Canada over public power programs in this country, and said no material designed for any U. S. project was diversted to Shipshaw. Certain Shipshaw forgings were produced in this country, he said, but dollar value of all Shipshaw materials made in this country was less than four percent of the entire Canadian cost.

"If we had used these materials in the U. S.," Batt declared, "it cannot be said that even one kilowatt of additional generating capacity would have resulted in this country. Moreover, as I wish to emphasize, we were able to get the Canadian aluminum more quickly than anywhere else."

As the aluminum demands grew, the Canadian contract was doubled, after a report by the Federal Power Commission and OPM in June, 1941, showed that capacity to produce only 600,000,000 pounds of aluminum could be obtained in this country by the stipulated time, this by means of power pooling, strengthening interconnections and shaving reserve margins. In doubling the Canadian contract, the required additional aluminum and an additional 70,000 kw. were obtained for Massena.

Shasta Units Sent to Coulee

The 150,000 kw. obtained for the northwest over and above the amount Fortas thought could be installed in time came about through the diversion of two 75,000-kw. Shasta units to Grand Coulee, where they went into operation long before they could have at Shasta, Batt pointed out.

"In 1943," Batt said, "we obtained 464,338,000 pounds of aluminum from Canada under the Shipshaw contract. In addition to the aluminum we actually got from Canada, the development of Shipshaw enabled us to keep the Massena Plant in operation and to increase its capacity by a substantial amount. Without Shipshaw we might have lost 165,000 kw., roughly equivalent to 150,000,000 pounds of aluminum a year; with Shipshaw, we retained this amount and added enough power to make another 60,000,000 pounds of metal a

Maine Brownout Lifted

The entire state of Maine has been exempted from terms of order U-9 on the basis of the availability of ample hydro capacity to cut the use of scarce fuels to a point at which no savings would be possible under continuation of the brownout. The exemption is good until June 30, with the provision that if any scarce fuel be required to meet loads, OWU's Conservation Branch shall be notified.

year. At the same time, power was assured for the growing needs of the Dominion itself, which was thereby enabled greatly to expand its role as a partner in hemisphere defense and as one of the arsenals of Democracy."

W. L. Clayton, Assistant Secretary of State and in 1941 Deputy Administrator of the Federal Loan Agency, under which RFC advanced the Shipshaw funds, was expected to testify and there was some possibility that J. A. Krug, WPB chairman and head of OPM's power branch when the aluminum program was being expanded, may testify.

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'Jacona' Power Ship Taken by Government

The "Jacona," floating power plant of the New England Public Service Co., has been requisitioned by the War Shipping Administration for service at an unrevealed destination.

Since April, 1931, the "Jacona" has been at Portsmouth, N. H., where it has been connected to the lines of the Public Service Co. of New Hampshire. It has been supplying the system with 20,000 kw. which was transmitted to a shore substation at 11 kv. and then stepped up to 66 kv.

The loss of capacity will not produce a power shortage on the system if no breakdowns occur to remaining steam production equipment and if existing and proposed interconnections with neighboring utilities can be used to take the place of the "Jacona" in periods of low water. Operating costs will be increased because of the use of less efficient stations and because of the increase in purchased power.

The "Jacona" was launched in 1919 as a single screw, two-deck, three-island type cargo steamer of 5,238 gross tons. It has a length of 396 ft. and a beam of 53 ft. The New England Public Service Co. converted it in 1930 into a floating power plant at a cost of approximately two-thirds that of a plant of equal capacity located on land.

Its first service was at Bucksport, Me., in November, 1930, when its two turbogenerators were connected to the lines of the Central Maine Power Co. to supply power for a large tidewater paper mill until the Wyman plant at Bingham was ready to deliver power.

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Pharr Succeeds Dunlap

Samuel S. Pharr has been appointed to the Tennessee Railroad and Public Utilities Commission by Governor J. Nance McCord to succeed Porter Dunlap who resigned after 22 year's service.

Potomac Basin Plan Abandoned by Army

Engineers Accede to Protests of 1,200 Residents Who Came to Washington for Public Hearing

The Board of Army Engineers for Rivers and Harbors will "submit an adverse report" on the proposal to build 14 multi-purpose dams in the Potomac River Basin, advanced by the District Engineers, after nearly 1,200 residents of Virginia, West Virginia and Maryland trooped to Washington to oppose the project at a public hearing last week.

The forthcoming rejection was made known in a letter to Senator Harry F. Byrd, Virginia Democrat, from Brig. Gen. John J. Kingman, senior member of the Board, following a request by Senator Byrd for another hearing in his state to register added protests.

More than a half dozen members of Congress led the attack against the plan at the hearing, pointing out that the $235,000,000 project would flood thousands of acres of fertile farmland, would dislocate the homelife of hundreds of people, inundate some of the Nation's most historic landmarks, and necessitate the removal and relocation of highways and railroads. Senator Byrd criticized the district engineers who drafted the report for taking an authorization to study flood control and "coming back with a project that is more than 90 percent for the creation of hydroelectric power," adding that if the plan had been for flood control alone, very few people would have protested.

Rep. A. Willis Robertson, Virginia Democrat, said that the project was 100 percent a power project for a community that does not need power, and declared:

"I challenge the legal and moral right of the Federal Government to condemn private property so that the Government can produce power in competition with private industry."

Senator Chapman Revercomb, West Virginia Republican, declared that the construction would involve the relocation of highways and rail lines at a cost dwarfing that estimated for the dams.

Rep. Jennings Randolph, West Virginia Democrat and chairman of the House District of Columbia Committee, had appealed directly to President Roosevelt to use his influence to kill the project. In a message to the President he said:

"I urgently request your careful study and, I hope, your opposition to the Potomac River power and flood control proposal of Army engineers."

In addition to the protests of the Congressmen and individuals, several organizations voiced their disapproval of the project, including the Washington Board of Trade, the Fine Arts Commission, and the National Park Service, an Interior Department subsidiary.

There was virtually no opposition to the completion of the Savage River Dam, near Piedmont, W. Va., now about 70 percent finished, which was halted several years ago because of

OPPONENTS OF POTOMAC PROJECT—Part of the 1,200 objectors to the Army Engineers' plan for developing the Potomac River basin listen to testimony at the public hearing in the Interior Department Auditorium at Washington. Two prominent opponents of the plan were Congressman Howard W. Smith, Virginia Democrat, in foreground with arms folded, and at his left, without vest, Senator Byrd of Virginia

restrictions brought about by the war.

Only a few in favor of the dams project participated actively in the hearing. Mrs. Clifford Durr of Alexandria, Va., member of The Committee for Potomac Development and wife of a Federal Communications Commissioner, asserted that the project would "form a basis for the industrialization of Virginia—the thing it needs most," adding:

"If, as has been said, we have enough power facilities now, why are rates so high and why is a brownout necessary?"

A spokesman for the Washington Central Labor Union, AFL, urged a program patterned after the TVA to provide cheaper power, end flood damage, prevent soil erosion and thus raise the standard of living, especially in rural areas. He added that the project would offer a substitute for coal.

The D. C. Industrial Union Council, CIO, expressed "tentative approval of the objectives of this project."

The Board's adverse report will be placed before Maj. Gen. Eugene Reybold, Chief of Engineers, who will make a further study. Copies of his report will be sent to the governors of the states and the agencies affected by the project for their comments or recommendations. Then the report goes to Congress for consideration by the House Committee on Flood Control.

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Union Electric Co. Takes Over Laclede Power Co.

Beginning this month the Union Electric Co. of Missouri will serve 40,000 former customers of the Laclede Power & Light Co. which has been purchased by the St. Louis utility. Completion of the purchase transaction was announced March 29 by Union Electric's president J. W. McAfee. Among the facilities of the Laclede system that were acquired is the Mound Street power plant with a capacity of 40,000 kw. Some 150 employes of the Laclede company have joined the Union Electric personnel.

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Upholds Revenue Reduction

A petition of the W. M. Smith Lumber Co., Jackson, contesting the order of the Alabama Public Service Commission to the Alabama Power Co. to reduce its 1944 revenue from residential and street lighting customers by approximately $600,000 has been dismissed by the commission on the grounds that the petition did not show the lumber company had sufficient interest to intervene.

SEC, TVA Win Cases Before Supreme Court

By 4-4 Decision, Pacific Gas & Electric Denied Rehearing on SEC Ruling That It Is North American Subsidiary—Jefferson County, Tenn., Loses Suit over Road Damage by Floods from TVA's Douglas Dam

The Supreme Court upheld the Securities and Exchange Commission and the Tennessee Valley Authority this week by denying the Pacific Gas & Electric Co. a rehearing on an SEC ruling holding it a subsidiary of the North American Co. and by refusing to review a circuit court order dismissing a complaint against TVA by Jefferson County, Tenn.

The P.G.&E. case was decided March 12 when the court split 4-4, with Mr. Justice Douglas not participating. In the absence of a majority vote against the lower court, its decision was affirmed.

Jefferson County sought review of circuit court affirmation of a district court decision which threw out the county's request for summary judgment against TVA in the matter of road damages. When 120 miles of the county's road system were flooded by the filling of Douglas Dam reservoir, TVA replaced them to the extent required to return the road system to the degree of usefulness it possessed before the dam was built. The replacement, which removed a net 84 miles of road from the system, was agreed to by the county so far as it was a question of maintaining the system's utility, but the county reserved the right to seek indemnification for the actual mileage destroyed and not replaced. TVA, in opposing the request for review, argued that its liability under the "due process amendment" was limited to restoring the system to the standard of usefulness it reached before construction of the dam.

Will Review Long Island Case

The court recently agreed to review a circuit court decision which denied SEC an injunction against the Long Island Lighting Co. SEC, which some time ago granted the company a certificate declaring it not a public utility under the Holding Company Act, sought to hold up the establishment of a re-capitalization plan approved by Long Island stockholders and by the New York State Public Service Commission. SEC has pending hearings on revocation of the company's certificate of exemption from requirements of the Holding Company Act.

In opposing SEC's request for review, the company asserted that:

"This procedure was brought by petitioner (SEC) wholly on the hypothesis that at some future date, petitioner might, after hearing and consideration of the evidence, revoke the certificate of exemption; find the Long Island is engaged in interstate commerce; require that Long Island register as a public utility; and entertain a preceeding under Section 11 of the (Holding Company) Act to inquire into its capital structure."

It added that the lower court had ruled:

"This it (SEC) has not done and may not do."

Any interference by the courts at this stage, the company asserted, would "inevitably impair the powers and jurisdiction of state instrumentalities."

Cases Involve Stockholders

After hearing brief arguments last week, the court had before it for decision two cases involving the extent to which stockholders may litigate actions unfavorable to their companies in the absence of action by the companies themselves.

One case is that of the American Power & Light Co. vs. SEC. The commission was upheld by the circuit court in an order holding up dividend payments on common and preferred stock to A.P.&L. by the Florida Power Co., an A.P.&L. subsidiary. In addition, the order directed F.P.&L. to remove $1,815,655 from its surplus and to appropriate from surplus $700,000 yearly until approximately $10,000,000 had been so appropriated. SEC argued that Florida Power & Light is the only agency which may seek court review of the order and that A.P.&L. as a mere stockholder of F.P.&L. may not do so.

The other case, described by SEC as a "facet" of the A.P.&L.-SEC case, is that of SEC vs. Samuel Okin. As a minority stockholder of the Electric Bond & Share Co., Okin sought to halt an SEC-approved transaction whereby American & Foreign Power Co., an E.B.&S. subsidiary, settled a $35,000,000 note held by E.B.&S. by paying E.B.&S. $5,000,000 in cash and issuing it $30,000,000 worth of new notes at a lower interest rate. Lower courts held

Okin to be a "person aggrieved" under the Holding Company Act when Okin sought review of the transaction. SEC argued that he was not aggrieved and that he was entitled to review of the transaction only when he can show that E.B.&S. directors, by their action or failure to act, were guilty of fraud, or a breach of trust or duty.

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5% Fire Insurance Cut on Utility Property Proposed

A five percent reduction of fire insurance rates on certain types of electric utility property has been recommended by the Central Traction and Lighting Bureau to constituent regional rating organizations and will become effective upon adoption by the regional authorities.

The rate reduction comes as a result of negotiations with the Central Bureau by the Edison Electric Institute Insurance Committee.

The recommended addenda to the Electric Generating Stations Schedule is "Final Rate Adjustment—Deduct 5 percent from the final rates (including floater rates) produced by this schedule. This credit to apply to both buildings and contents whether written under specific or blanket form, and to apply after any charge has been made for the Inherent Explosion Clause."

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Independent Union Leader Gets Appointment to WLB

What is believed to be the first appointment of a member of an independent union to a Regional War Labor Board was that of George L. Mueller, president of the Independent Association of Employees of Duquesne Light Co., as a labor member of the Third Regional War Labor Board's electric utility wage bracket panel. A large percentage of utility workers in the Pittsburgh area are enrolled in independents.

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Canadian Output Drops

Continuing the trend of the past months, central stations in Canada again showed a decrease in output in February. Output was 3,124,235,000 kw.-hr. as compared with 3,298,017,000 kw.-hr. in February, 1944, or a loss of over 5 percent. The January output was 3,422,683,000 kw.-hr.

Output of primary power declined from 3,080,771,000 to 2,645,482,000 kw.-hr., but secondary power increased from 217,246,000 to 478,753,000 kw.-hr.

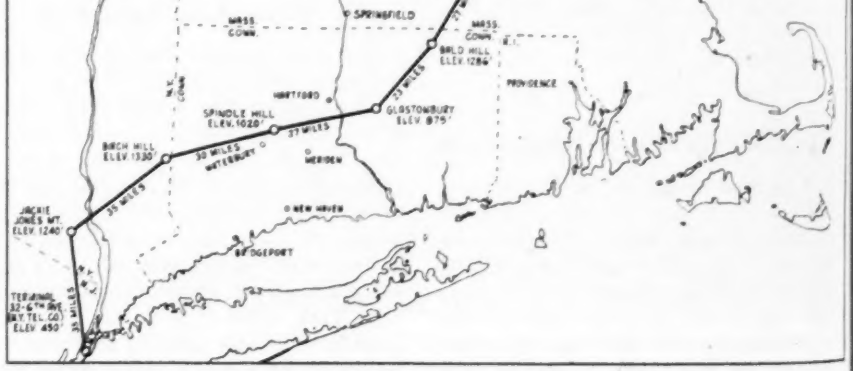
A.T. & T. to Test Radio Relay for Television

To determine in practical operation the relative efficiency and economy of radio relay for transmission of long distance telephone messages and of sound and television programs, compared with transmission over wires and cables and the recently developed coaxial cable, the American Telephone & Telegraph Co. has filed application with the Federal Communications Commission for authority to construct seven relay stations between New York and Boston.

Between the New York terminal, atop A.T.&T.'s Long Lines Building, and the Boston terminal, atop the Bowdoin Square Building of the New England Telephone & Telegraph Co., relay stations will be built about 30 miles apart. These sites were chosen for their elevation because microwaves do not travel much farther than the horizon and because in this way the transmitting and receiving antennas are well above intervening obstructions so that the waves can be beamed from hill to hill.

The New York-Boston experiments are planned in three parts of the radio frequency spectrum—near 2,000, 4,000 and 12,000 megacycles. Eight channel assignments, each 20 megacycles wide, are being requested from the FCC in each of these parts of the spectrum. It is planned to use the eight channels to provide two simultaneous transmissions in each direction, with different frequencies in adjacent relay sections.

If the experimental facilities prove successful, similar systems will be laid out throughout the nation; spur connections will also be made to nearby cities and towns as the demand for them grows in post-war years.



SITES FOR RELAY STATIONS—Beamed from station to station, messages and pictures will be sent by radio under an experimental program planned by the American Telephone & Telegraph Co.

Exemption from Brownout Till October Plea of BPA

Exemption from the War Production Board brownout through October, 1945, has been requested from the Office of War Utilities by the Bonneville Power Administration following a review of Pacific Northwest power loads and resources.

Presently exempt from the fuel-saving order through July, Bonneville officials report that the Bonneville-Grand Coulee power system will have sufficient surplus energy available under critical water conditions to carry deficiencies of other utilities in the region for the period extending through October.

The request for continued exemption in the Pacific Northwest is being made particularly on behalf of small agencies which are not members of the Northwest power pool, including municipalities, rural electric cooperatives and public utility districts, officials state.

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Consolidated of Baltimore Reports Rise in Demand

The amount of electricity sold in 1944 by the Consolidated Gas, Electric Light & Power Co. of Baltimore was 80 percent greater than the amount sold in 1939, President Charles M. Cohn revealed in his annual report.

To meet this demand Consolidated increased its generating capacity from 251,000 kw. in 1939 to 462,000 kw. in 1944.

Evidence that the company's war load may have reached a plateau are indicated by the 5 percent increase in revenue last year as compared with increases of 8.5 percent in 1943, 10 percent in 1942, and 12.9 percent in 1941.

Wisconsin Utilities Establish Fellowship

Association Will Back 4-Year Study of Economic Use of Electricity on Dairy Farmstead

Regents of the University of Wisconsin, Madison, last month approved a fellowship agreement with the Wisconsin Utilities Association providing for a four-year study of the "economic use of electric light, heat and power for all phases of the dairy farmstead, with the purpose of saving milk production."

Under the fellowship agreement, approved by the board of regents, the University is to receive $52,000 for expenses in conducting the research over a four-year period.

The project will be under the supervision of F. W. Duffee, agricultural engineer and I. W. Rupel, dairy husbandman both of the College of Agriculture. The work will be undertaken on a 144-acre farm about five miles from Madison, Wisconsin, and will begin as soon after April 1, this year, as the wartime emergency will permit.

This latest project follows the line of other original research work conducted by the University of Wisconsin, 20 years ago, under successive fellowships, established by the Wisconsin Utilities Association, which pioneered rural electrification in Wisconsin and paved the way for the present farmer acceptance of electrification.

Prof. Duffee convinced representatives of the association that an extensive research project, designed to dig out the facts on labor saving through electrical mechanization, would prove beneficial to the state farmers, the university, the utility industry and might do more to improve farming than has been done for decades.

University officials said that the first phase of the investigation will include time-and-cost studies of methods dairy farmers now use in doing chores. With the records thus obtained for comparison, the next step will be to erect and remodel buildings, and test equipment, to determine how present methods can be improved.

Representatives of the Wisconsin Utilities Association who negotiated the agreement with the college of Agriculture officials included S. B. Sherman, association president and vice-president and general manager of Wisconsin Gas & Electric Co., Racine; C. E. Kohlhepp, vice-president and general manager Wisconsin Public Service Corp., Milwaukee; G. C. Neff, president, Wisconsin Power & Light Co., Madison; G. V. Rork, president, Northern States Power Co., Eau Claire and A. F. Herwig, Milwaukee, executive secretary of the association.

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Ontario Hydro Reveals $22,000,000 Rural Plan

A $22,000,000 electrification plan designed to bring electricity to 57,400 new rural customers and to 85 percent of Ontario farms within five years after the war ends has been announced by George H. Challies, vice-chairman of the Hydro-Electric Power Commission of Ontario.

The $22,000,000 expenditure by the commission will be for labor and materials, with the government providing a grant-in-aid to cover 50 percent of that cost.

Under the plan the Rural Power District Loan Act will be reinvoked with the interest rate reduced from five to four percent to assist farmers in the purchase of necessary electrical equipment and appliances.

Expenditures of the 204,500 consumers which will be on the lines at the completion of the plan are estimated at $39,000,000, divided as follows: wiring of farms and homes, $9,000,000; farm equipment, $5,000,000; farm home appliances, $16,000,000; and non-farm home appliances, $9,000,000.

PEOPLES POWER COMMISSION—Organized to take over Nebraska Power Co. under LB204, the Commission holds organization meeting. Left to right, Roy E. Bott; Charles D. Saunders, secretary; Samuel L. Cooper, vice-chairman; Karl C. Brown; Mayor Dan Butler of Omaha, only holdover from the old PPC; David Goldman; J. M. Harding, chairman; and C. E. Metzer. Clarence L. Kirkland was absent

P.U.D. Starts Move to Take Over Utility

Stevens County Group Adopts Resolution to Condemn Facilities of Washington Water Power

A bitter battle between public and private power utilities loomed anew in Washington state last week as another P.U.D. apparently operating on the set pattern of "divide and conquer," put wheels in motion for condemnation of a sizable chunk of Washington Water Power Co. facilities.

The move, made by the eight-year-old Stevens County P.U.D. No. 1, which adopted a resolution to acquire all of the Spokane company's properties in Stevens County in northeast Washington, showed promise of being a case designed to test the efficacy of new state laws aimed at aiding the P.U.D.'s.

Probably one of the first of these to come under fire would be a law, fresh on the statute books from a public-power minded legislature, requiring private utilities in condemnation proceedings to file with the Washington State Department of Public Service, wholesale power rates to P.U.D.'s instituting the proceedings.

Utilities Doubt Constitutionality

Private power interests, however, expressed strong doubt of the constitutionality of the act, confidently pointing to a decision of the State Supreme Court from which, perhaps, the law was born.

In an action against Washington Water Power, Okanogan County P.U.D. No. 1 had been thrice thwarted in demands for filing of such rates—once by the Department of Public Service, again by the Thurston County Superior Court and finally by the State Supreme Court.

However, doubt as to whether the Stevens County P.U.D. would turn to the Spokane utility for such power was evidenced in a statement by Walter D. Smith, president of the P.U.D. Commission.

"Full development of all our resources in this county can come only when low-cost power is available to all the county," said Smith. "The Grand Coulee Dam is producing huge quantities of power at extremely low prices just a few miles from Stevens County.

"Without adequate distribution facilities here, the great power development at Coulee Dam is of no value to the area. Our action is paving the way for complete and adequate distribution of electric power in Stevens County."

Thus also the P.U.D. official manifested the Commission's idea of an equitable "solution" for the develop-

ment of power and resources in Stevens County . . . . simply take the distribution system built up by a private power concern and sell federally produced power through it.

To carry out the extensive acquisition of Washington Water Power facilities, the Commission voted to issue and sell $2,000,000 worth of revenue bonds in $1,000 denomination, named W. S. McCrea, Jr., of Tacoma as engineer to make the necessary surveys of the properties and employed Thomas I. Oakshott of Colville as attorney for the District.

Facilities listed in the resolution include 16 substations and equipment, one 60-kv. and four 33-kv. transmission lines and all communication lines and equipment in connection with them, the company's Meyers Falls hydroelectric generating plant on the Colville River near Kettle Falls, the general plant and equipment at Colville, all franchises and other publicly granted rights and all property owned and leased by the company in the county.

Officials of the Spokane firm were mum on the condemnation resolution, explaining warily they had not yet viewed it. Other private power officials, however, tartly asserted the $2,000,000 appraisal by the P.U.D. is "probably only about half what it ought to be."

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Passamaquoddy Authority Act Gets Maine Approval

An act creating a Passamaquoddy District Authority comprised of a seven-member board of directors to be named by the governor with executive council approval has been signed by Governor Horace A. Hildreth of Maine.

The P. D. A. is given authority to acquire property for the manufacture, production and generation of power and to transmit, distribute and sell water, steam, electric, hydroelectric and tidal electric power. It cannot distribute or sell power for other than industrial uses in any community within an area now served by an existing electric or water power utility without consent of the Public Utilities Commission.

The new legislation is considered an enabling act should the Federal government again undertake a Quoddy project.

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Co-op to Erect Rural Lines

Warren Rural Electric Corp. has been authorized by the Kentucky Public Service Commission to construct 125 miles of lines in the Counties of Butler, Edmonson, Grayson, Logan, Simpson, Ohio, and Warren.

Oregon's P.U.D. Act Will Face Constitutionality Test

Oregon's newly enacted Chesman Act, limiting operations of Public Utility Districts, will face a test of its legality in the state supreme court, Morton Tompkins, master of the Oregon State Grange and head of the legislative lobby against the measure, announced recently in Portland. The attack, he suggests, will be made by one of the several P.U.D.'s, scattered over the state, which plan to expand their boundaries to areas adjacent to their present limits.

The home rule provision of the act, which enables cities in P.U.D. areas to decide for themselves whether they wish to be included in the districts, is the bone of contention. It provides that no municipality may be absorbed by an expanding P.U.D. unless a majority of its voters so wish.

Mr. Tompkins insists this will give cities, particularly smaller cities, power to block P.U.D. expansion by voting against inclusion, thus, in effect, becoming islands surrounded by the districts. Court action is anticipated in the near future because P.U.D. expansion is planned when the war ends.

The Grange head expressed surprise that Oregon's governor had signed the bill so hastily, after it had been enacted, in the face of an opinion from the attorney general questioning its constitutionality. The attorney general's opinion was repudiated, however, by Attorney Wilber Henderson, advisor to the governor during the legislative session, and Attorney Ralph Moody, legal advisor to the senate.

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Chicago Utility Will Add Units at Calumet Station

Necessary priorities have been granted the Commonwealth Edison Co., for the installation of a 107,000-kw. turbo-generator unit and related steam generating equipment at Calumet Station in Chicago, Charles Y. Freeman, chairman of the board, stated last week in his annual address to stockholders.

Installation of the Calumet unit will cost approximately $12,900,000 and will require 20 months to complete. Although it is hoped that the war will be over by the time it comes into service, this additional Calumet unit, in times of expected lesser output, will justify itself by effecting economies through its operation in place of older, less efficient equipment that will then be reserved for peak-hour loads.

Two steam generating units each rated 600,000 lb. per hr. will supply steam to the turbine at a throttle pressure of 1,250 psi. and a temperature of 925 deg. F.

Other construction work on the system is, according to Mr. Freeman, being held to a minimum in the absence of any special projects, 1944 construction expenditures totaled $11,286,000. This compares with an average yearly expenditure of $39,000,000 for the pre-war years of 1940 and 1941. Mr. Freeman estimated that construction work in 1945 may amount to as much as $20,000,000 because of additions to the Calumet and Dixon generating stations. He pointed out, however, that major expenditures on the Calumet installation will not actually be made during this year.

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J. Leo Scanlon Will Buy 2 Midwest Utility Firms

J. Leo Scanlon, who operates the J. Leo Scanlon Co., Buffalo, N. Y., has confirmed the signing of a contract for his acquisition of the Missouri Service Co. and the Northern Kansas Power Co. from the Engineers Public Service Co., parent company of the two utilities, for $750,000, subject to adjustments.

The two utilities provide power in towns of Missouri, Iowa, Nebraska and Kansas. The Scanlon concern is a manufacturers' agent, selling electrical equipment to utilities and industries.

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Forest City, N. C., Will Buy System in Nearby Town

The electric lines, equipment, and the franchise for electric lighting in Alexander Mills, N. C., will be taken over by Forest City, N. C. as soon as contracts are signed.

The purchase price of $1,000 includes power lines, meters, and any tangible property needed to operate the system. The franchise will give the municipal the right to serve 100 homes and business places in the town of Alexander Mills but does not include furnishing power to the Alexander Mills or any houses owned by that concern.

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Missouri P.S.C. Calls Sale of Springfield Utility Void

The Missouri Public Service Commission has declared that the Springfield Gas & Electric Co. sold its property to the City of Springfield without Commission authority and has ordered the company to show cause why the transaction is not unlawful and void and why the P.S.C. shouldn't order the company to resume its operations and service.

Increased Stream Flow Reported During February

Throughout the United States at the end of February there was an increasing stream flow and accumulation of ground water, the United States Geological Survey reported. In Canada, stream flow continued deficient in southern Ontario and further recession was noted in northern Quebec, the Dominion Water and Power Bureau reported.

More than normal accumulation of snow prevailed in the Northeastern States, with some decrease of flood hazard was brought about during the latter part of the month by thaws in the lower and coastal areas.

Excessive runoff was reported in the West Central States from Texas to North Dakota. The runoff of Guadalupe River in Texas was highest of record for February.

Substantial increases in flow of streams occurred in the Pacific Coast States and in Nevada. Prospects for normal runoff during the irrigation season in the 11 Western States were widely reported to be unfavorable.

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FPC Approves Changes of Interstate Power Co.

Proposals of the Interstate Power Co., Dubuque, Ia., to eliminate $23,764,829 from its plant accounts have been approved by the Federal Power Commission. These adjustments were established as of January 1, 1941, in connection with the company's reclassification and original cost studies of electric plant, except for $14,484 which arose through a minor property acquisition during 1944.

The company proposes to dispose of $17,217,255 by immediate charges to earned and capital surplus. The remaining of $6,547,574 will be amortized over a 15-year period by equal monthly charges to income beginning with September 1945. The FPC order provides, however, that the company may accelerate the amortization.

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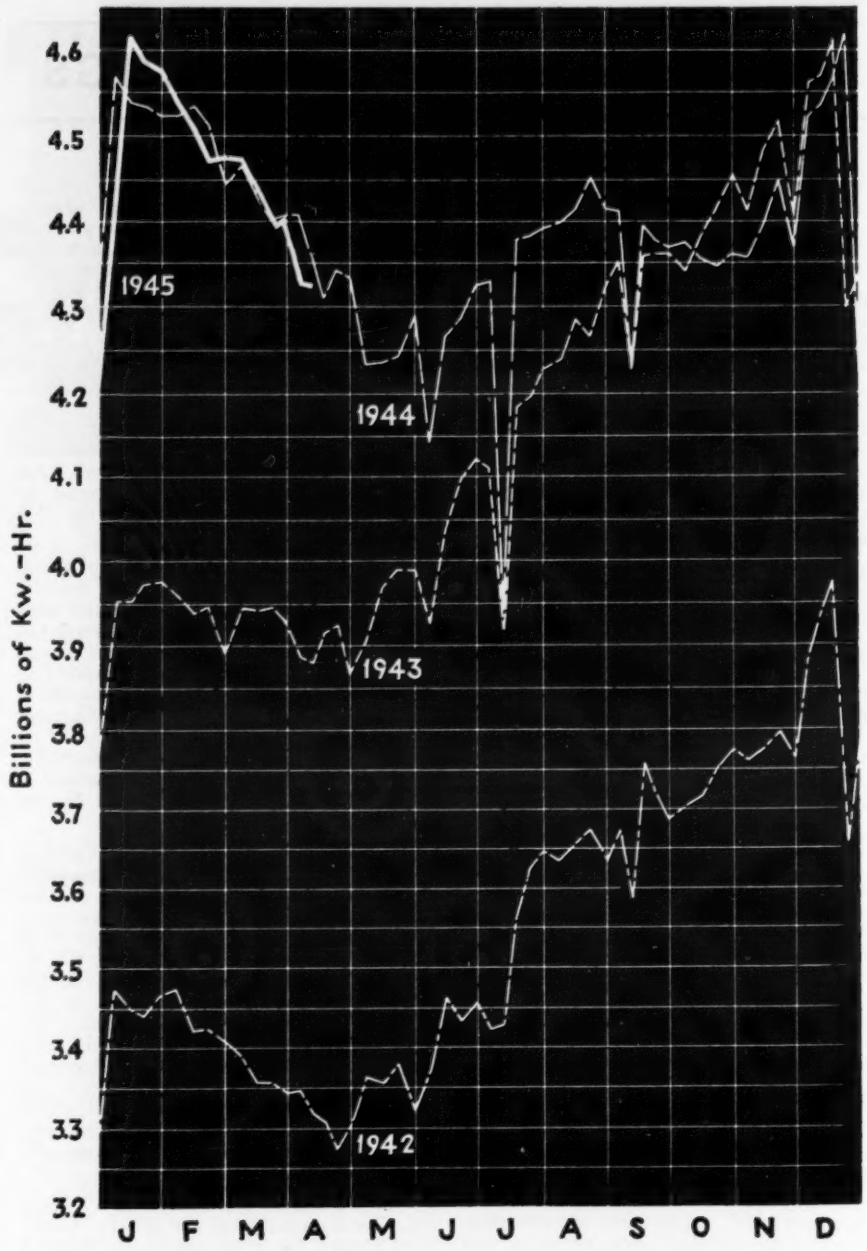
Ontario Hydro Operating Northern Ontario System

Ontario Hydro-Electric Power Commission on March 27 took over complete operation of the Northern Ontario Power Co. which it purchased late last year (ELECTRICAL WORLD, January 6, Page 78). Dr. T. H. Hogg, chairman of Hydro, indicated that there would be no immediate changes in domestic rates and no staff changes at plants acquired.



Output Curve Continues Downward

The electric output curve continued downward during the week ended April 7, 1945, according to figures released by the Edison Electric Institute. The amount of electric energy distributed by the light and power industry totaled 4,321,794,000 kw.-hr. compared with 4,329,478,000 kw.-hr. during the preceding week. During the week ended April 8, 1944, the amount of electric energy distributed amounted to 4,361,094,000 kw.-hr., this year's figure representing a decrease of 0.9 percent.

The West Central group of states showed a 9.4 percent increase over the corresponding week of 1944, and the Pacific Coast section showed the highest loss with a decrease of 6 percent. The decrease in the Mid-Atlantic section was nearly as high, 5.2 percent.

Weekly Output Millions Kw.-Hr.

1945		1944		1943	
Apr. 7	4,322	Apr. 8	4,361	Apr. 10	3,882
Mar. 31	4,329	Apr. 1	4,409	Apr. 3	3,890
Mar. 24	4,402	Mar. 25	4,409	Mar. 27	3,928
Mar. 17	4,398	Mar. 18	4,400	Mar. 20	3,947
Mar. 10	4,446	Mar. 11	4,426	Mar. 13	3,945
Mar. 3	4,472	Mar. 4	4,465	Mar. 6	3,947
Feb. 24	4,474	Feb. 26	4,445	Feb. 27	3,893
Feb. 17	4,472	Feb. 19	4,512	Feb. 20	3,949
Feb. 10	4,505	Feb. 12	4,533	Feb. 13	3,940
Feb. 3	4,539	Feb. 5	4,524	Feb. 6	3,960
Jan. 27	4,577	Jan. 29	4,524	Jan. 30	3,977
Jan. 20	4,588	Jan. 22	4,532	Jan. 23	3,974
Jan. 13	4,614	Jan. 15	4,539	Jan. 16	3,952

Percent Change from Previous Year

	Week Ending		
	Apr. 7	Mar. 31	Mar. 24
New England	+ 1.2	— 0.4	+ 3.7
Mid Atlantic	— 5.2	— 6.2	— 3.0
Central Industrial	+ 0.8	+ 0.2	+ 1.8
West Central	+ 9.4	+ 6.1	+ 5.3
Southern States	+ 4.9	+ 4.6	+ 3.6
Rocky Mountain	— 3.8	— 7.4	—10.0
Pacific Coast	— 6.0	— 6.5	— 2.1
Total United States	— 0.9	— 1.8	— 0.2

SEC DECISIONS—HEARINGS

The Securities and Exchange Commission, in a series of orders recently issued affecting electric utility companies:

HAS AUTHORIZED the Lake Superior District Power Co. to issue and sell to North West Utilities Co., present owner of all outstanding common stock, one additional share of $75 par common stock, thus increasing the number of shares to 35,600. Lake Superior may then reduce and change its authorized capital from $11,235,025 composed of 70,000 shares of preferred stock of $100 par value and 56,467 shares of $75 common stock to an authorized capital of $11,235,000 composed of the same number of preferred shares and 211,750 shares of $20 common stock; and may change the 35,600 shares of $75 common outstanding into 133,500 shares of $20 common by splitting the $75 shares into 3.75 shares of $20 common.

HAS APPROVED Associated Electric Co.'s proposed open account advance of $2,500,000 to its subsidiary, Manila Electric Co., to aid in the rehabilitation of Manila's personnel and physical facilities. The loan is to be made without interest.

HAS APPROVED Ogden Corp.'s proposal to sell at public auction 54,000 unclaimed shares of its $4 par value common stock. The shares were among those issued during the reorganization of Ogden's predecessor, Utilities Power & Light Corp., to holders of Utilities' securities. Ogden reserves the right to bid not less than $3.75 a share for such stock to prevent selling at a sacrifice and will cancel stock thus acquired. Proceeds are to be held for the benefit of security holders for six years. SEC reserved jurisdiction with respect to the sale price of the stock.

HAS EXTENDED until December 31, the exemption of General Electric Co. and two subsidiaries from provisions of the Holding Company Act. The company said it is "impracticable" at present to sell their holdings in the prior lien preferred and preferred stock of New England Public Service Co., as required in a SEC order of March 16, 1938. G.E., Electrical Securities Corp. and G.E. Employees Securities Corp. hold 307,005 shares of New England common and 35,000 shares of its preferred stock. The companies have agreed not to dispose of the stock until New England's reorganization has been approved by SEC.

HAS APPROVED the proposal of Delaware Power & Light Co. and its subsidiary, Eastern Shore Public Service Co. of Maryland, to sell Eastern Shore's electric and ice properties in St. Mary's, Charles, Prince George's and Calvert Counties, Maryland, to Southern Maryland Electric Cooperative, Inc., for a base purchase price of $850,000.

HAS APPROVED the application of Electric Power & Light Co. and its subsidiary, Dallas Power & Light Co., to retire all of the outstanding preferred stock of Dallas, consisting of 35,000 shares of 7 percent, $100 par value preferred and 43,731 shares of $6 preferred without par value, by offering stockholders the right to exchange it on a share for share basis for a new 4½ percent, $100 par value stock. Any shares not exchanged will be called at $110 per share plus accrued dividends. Funds for redemption will be obtained from the sale of common stock to Dallas' common stockholders on a pro rata basis at $60. Any such common stock not sold will be bought by Electric Power.

HAS APPROVED a proposal of the Haverhill Electric Co. to issue and sell for cash 26,000 shares of additional capital stock at its par value of $25 by offering such shares to stockholders in proportion to present holdings. The proceeds, $650,000, to be used to pay part of $800,000 indebtedness to North Boston Lighting Properties. Approval of Haverhill stockholders must be obtained within 30 days of date of the SEC order.

HAS EXTENDED for one year from March 30, 1945, the period allowed the Federal Light & Traction Co. to complete the sales of Tucson Gas, Electric Light & Power Co. and two affiliated companies, Stonewall Electric Co. and Tucson Rapid Transit Co., or to elect to retain the Tucson properties, along with Deming Ice & Electric Co., and dispose of its other properties as part of its integration plan. The request was made because of the possibility of an adverse vote in an election to approve purchase of Tucson property by the city.

HAS APPROVED the proposal of Carolina Power & Light Co. to retire all its outstanding $7 and $6 preferred stocks by offering stockholders the right of exchange on a share for share basis for a new issue of $5 preferred stock. Treasury funds will be used to redeem unexchanged shares at 110 plus accrued dividends. Carolina, a National Power & Light Co. subsidiary, has outstanding 93,553 shares of $7 and 79,955 shares of $6, a total of 173,508 shares of preferred. Since only 156,158 shares of the new $5 preferred will be issued, all shares over 90 percent of the outstanding preferred that are offered for exchange will be redeemed.

HAS EXTENDED until May 31, 1945 the time for consummating the sale by Associated Electric Co. of its subsidiary, Missouri General Utilities Co. to five cooperatives and the city of Rollo, Mo., for a base price of $1,610,000 subject to certain adjustments.

Hearing Scheduled

APRIL 18: On plan of North West Utilities Co. to sell through competitive bidding its interest in Lake Superior District Power Co., Ashland, Wis.

UTILITY REPORTS

	1945	1944
*Alabama Power	$3,936,611	$4,359,596
†American Gas & Electric and subs	12,242,884	11,563,979
*Central Maine Power	3,188,269	3,246,335
*Connecticut Light & Power	3,857,472	3,622,507
*Consumers Power	7,140,413	7,777,853
*Georgia Power	4,889,118	5,827,540
*Houston Lighting & Power	3,045,116	2,837,405
*Ohio Edison and sub.	3,499,554	3,852,158
*Tampa Electric	1,279,297	1,162,023
	1944	1943
‡Indianapolis Power & Light	2,082,615	2,077,312
‡New Jersey Power & Light	1,152,506	975,750

*Twelve months ended February 28.
†Twelve months ended January 31.
‡Twelve months ended December 31.

Connecticut Utilities Make Output Record Last Year

Connecticut utility companies for the sixth successive year set a new all-time record in 1944 both in generation and sale of electric current. This last annual total exceeded combined totals of any two years prior to 1939. Combined totals in 1944 of the Connecticut Light & Power Co., Hartford Electric Light Co., United Illuminating Co., and Connecticut Power Co., recorded an output of 2,391,217,000 kw.-hr., a two percent gain over 1943.

Connecticut Light & Power Co. led all companies in the state by dispensing above a billion kilowatt hours of electricity. This mark was never achieved in Connecticut before—a total of 1,005,024,000 kw.-hr. Bridgeport and New Haven divisions of the United Illuminating Co. accounted for 659,404,000 kw.-hr. Hartford Electric Light Co., 472,572,000; Connecticut Power Co., 218,217,000, all figures are peak for each company with the exception of the Hartford Electric Light Co. which dropped 1.5 percent below 1943.

•

Shasta Interim Wholesale Rates Get Ickes' Approval

Interim wholesale rates for electricity from Shasta Power Plant of California's Central Valley Project, amounting to about five mills per kilowatt-hour on a 50 percent load factor, have been approved by Secretary of the Interior Harold L. Ickes, it was announced recently. Rates are scheduled with the provision that they are subject to modification following post-war C.V.P. developments.

Though the bulk of Shasta's power (150,000 kw.) now is sold to the Pacific Gas & Electric Co. under a special wartime contract, 50,000 kw. may be withdrawn and sold to other customers, it is stipulated in the contract. Several municipalities in the Sacramento Valley are interested in purchasing Shasta power, the Bureau of Reclamation reports.

Rates announced, applying to firm power only, vary from 14.27 mills for a 10 percent monthly load factor to 3.56 mills for a 100 percent monthly load factor.

•

Municipal Gives Rebate

Remittances totalling about $10,000 were made to customers of the Oberlin, Ohio, municipal plant for the February 15-March 15 period because the surplus of the plant had reached $100,000.

HOW

DESIGN · CONSTRUCT · OPERATE · MAINTAIN

Fences Are Painted by "Flow-Coating" Method

An average of 400 ft. of high fence was painted in one day by a four to five-man crew of the Buffalo, Niagara Electric Power Corp., when the "flow-coating" method was used. As much as 488 ft. of 8-ft. fence was "flow-coated" in a single day by one crew.

The method required a portable board backing to prevent paint from blowing and to direct surplus paint into a trough under the fence. The splash boards were made of ¼-in. plywood, 4 ft. by 8 ft., and have hooks at top to attach them to the fence.

Paint was applied to the top by air compression, from the side opposite the boards, and flows down both sides of the fence. Surplus paint flowed into a trough and was used again. Three coats were applied to each fence—a rust killer, primer and final coat.

To "flow-coat" a 100-ft. length of 8-ft. high wire fence approximate amounts of paint materials required were as follows: Quantity of rust killer depended on condition of fence; 14.7 gal. of Savasal for thinner; 5.2 gal. of No. 701 primer; 4.7 gal. of Silver Gray finish; latter two are products of Sipes Paint Co., Pittsburgh, Pa.

•

Resag Conductors in Half Usual Time

Conductors on a 132-kv. transmission line from Chicago to Waukegan on the system of Public Service Co. of Northern Illinois were recently resagged in half the usual number of manhours thanks to a simplification of the normal procedure for removing slack from transmission lines.

The improved procedure, submitted as an employee suggestion, won for Victor E. Edholm an award of $300. Formerly the resagging of conductors was done by pulling slack from one dead-end tower to the next dead-end tower, one conductor at a time. This required the transfer of rigging and equipment the full length of the line between dead ends and necessitated climbing each transmission tower three times, hoisting equipment each time.

Under the simplified procedure when slack is to be pulled on a tower line the equipment is raised only once for each tower. Starting a certain convenient number of spans (usually about a mile) from one dead-end tower, the upper conductor is pulled up to the new sag and held until clamped in at the insulators. When the holding line is released for this first pull, each tower (back to the dead end) absorbs part of the tension. The operation is repeated for the middle and bottom conductors at this first pulling point.

Subsequent Pull Paints

Equipment is then lowered and moved on, about a mile to the second pulling point and again raised. From this second point conductors are pulled up until the insulator string at the first pull point is vertical. The second mile of wire is then pulled to its proper sag. It will of course be necessary to go back to the intervening towers between the dead-end structure and the first pull point and reset the conductor clamps so that the insulator strings are restored to vertical.

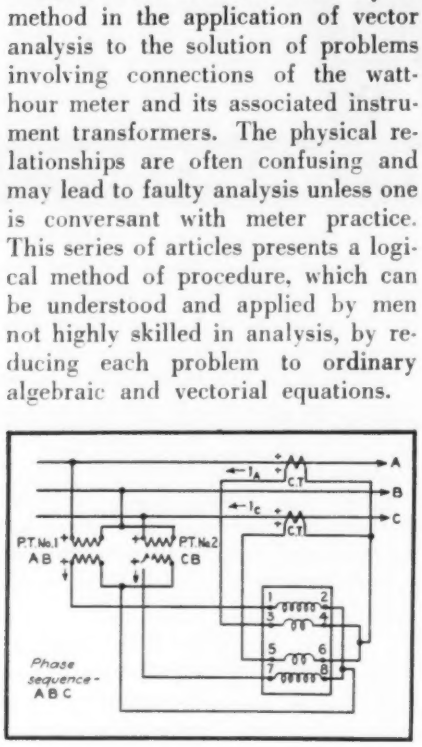
This procedure is repeated at the several pull points between dead ends, each time allowing the slack to run ahead. Finally, when the second dead-end tower is reached all accumulated slack is removed and the operation is completed for that line section.

BACKING BOARDS ARE SET UP (Left) and wire fence is painted by "flow-coating" method (right). Paint flows down both sides of the fence at once

Vector Analysis of Meter Connections—I

By NICHOLAS B. COOK
Public Service Elec. & Gas Co., Paterson, N. J.

There is considerable diversity of method in the application of vector analysis to the solution of problems involving connections of the watthour meter and its associated instrument transformers. The physical relationships are often confusing and may lead to faulty analysis unless one is conversant with meter practice. This series of articles presents a logical method of procedure, which can be understood and applied by men not highly skilled in analysis, by reducing each problem to ordinary algebraic and vectorial equations.



POLYPHASE watthour meter with its C.T. and P.T. properly connected in a three-phase three-wire circuit

Letters A, B and C in the diagram denote a phase sequence in which voltage AB leads voltage BC by 120 deg., etc. The positive sign indicates positive instantaneous polarity. Transpositive instantaneous polarity Transformer primary current flows toward the polarity mark, i.e. the primary current enters at the polarity mark; secondary current flows away from its polarity mark. Therefore the voltage across potential transformer No. 1 is E_{AB}; i.e. from A to B; the voltage across potential transformer No. 2 is E_{CB}. Secondary voltage takes its subscript designation from the primary.

Current in Meter Coils

In the watthour meter the current flow in all coils is assumed to be from left to right; i.e. from "line" side to "load" side.

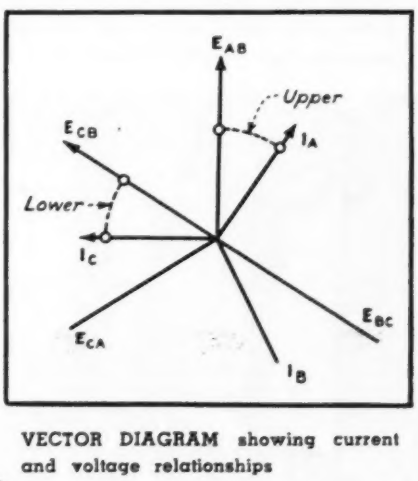
The current in each current coil may be found by Kirchhoff's First Law, namely that the vectorial sum of the currents directed toward any junction is zero; or in other words, that at any point in a circuit the sum of the currents flowing toward the point is equal to the sum of the currents flowing away from the point.

The voltage impressed upon each potential coil may be found by Kirchhoff's Second Law, namely that the vectorial sum of voltages taken completely around any circuit is equal to zero. Voltage drops (across potential coils) are considered negative; voltage rises (across transformers) are considered positive, with proper regard for the order of subscripts. When the voltage path through a transformer secondary winding proceeds from polarity (positive) to nonpolarity, that voltage takes the negative sign.

To show what currents and voltages are acting in a meter, draw a diagram of connections and set down the fundamental vector diagram. The arrowheads are omitted in order that they may later be attached only to those vectors that represent meter voltages and currents.

The phase rotation being known, the lines A, B, C can be properly identified. It is immaterial, vectorially, which line is designated as A or B or C so long as the order of lettering follows the phase sequence. In the vector diagram the conventional counter-clockwise rotation may always be used.

In the analysis of the diagram of connections the voltage between meter



VECTOR DIAGRAM showing current and voltage relationships

terminal 1 and terminal 2 is clearly E_{AB}, for by Kirchhoff's Second Law, $-E_{12}-E_{AB}=0$. Similarly the voltage between 7 and 8 is E_{CB}, or E_{BC} reversed. The current in 3-4 is transformer secondary current I_A since coil 3-4 is in series with the secondary winding of the current transformer in line A. The current in coil 5-6 is I_C. These relations are given in vectorial form assuming unity power factor and balanced load.

It can be shown that the power acting in the upper element is equal to the product of the voltage vector E_{AB} and the projection of the current vector I_A upon the vector E_{AB}; or in the upper element

$$P_{upper} = E_{AB}\, I_A \cos 30°$$

Similarly, in the lower element

$$P_{lower} = E_{CB}\, I_C \cos 30°$$

Since in a balanced three-phase system the line voltages are equal and the line currents are equal, the total power at unity power factor may be expressed by the equation

$$P = 2\ EI \cos 30°$$

$$\text{or } P = \sqrt{3}\ EI$$

If the power factor is lagging, the angle between E_{AB} and I_A is greater than 30° and

$$P_{upper} = E_{AB}\, I_A \cos (30° + \theta)$$

in which θ is the angle of lag.

For the same condition the angle between E_{CB} and I_C is less than 30°, unless θ is equal to or greater than 60°; and for any value of θ

$$P_{lower} = E_{CB}\, I_C \cos (30° - \theta)$$

The total power at balanced load is given by

$$P = \sqrt{3}\ EI \cos \theta$$

This expression is fundamental. It is the basic value of P against which must be compared all other values obtained by incorrect connections.

•

Fire Destroys Primaries; Restoration Unorthodox

One way of restoring service when poles and primaries have been destroyed by a fire in a nearby building is to wait for the fire to die down and proceed in the conventional manner. However, when these primaries feed a hospital and war plants and a delay cannot be countenanced, other methods must be found. This was the problem recently encountered by R. T. Cooney, general superintendent of the Lansdale Municipal Electric Department, Lansdale, Pa.

For a solution, 100 six-pin crossarms were laid on the ground spaced approximately 6 ft. apart. The necessary insulators installed and the No.

* First of a series of articles on vectorial solution of meter connections

2/0 copper tightly tied allowing no sag. The four 3-phase, 3-wire 2,300-volt circuits were installed in this manner for the three sections which were destroyed.

By utilizing this unorthodox construction complete service restoration was made in approximately 7½ hr. However, if the line crew had waited for the fire to die down and strung the primaries in the conventional manner, many additional hours of service outage would have resulted. As a safety measure, it was necessary to patrol this section of line until relocation on new poles was completed.

•

Portable Transformer for Relay Tests

By J. P. DAWSON,
Meter Engineer
Woodstock (Ont.) Public Utilities Commission

When our meter department is required to work on relays and meters in factories being served with 550-volt power we use a portable transformer only when the main switch is opened. The transformer is a standard 550-to-110-volt transformer rated 1 kw. sold under the name of control circuit transformer and intended to be used on 550 volts to supply some isolated device requiring 110 volts. These transformers are available in various capacities.

We mounted the transformer in a wooden box approximately 16 by 13 by 10 in. deep. The lid opens along the 16 by 13-in. side, and the box has a heavy leather strap for carrying.

Inside the box we mounted a fuse on the incoming side, and two duplex convenience outlets as output from the secondary. It will operate an electric drill and all the portable lights we need, and then without the drill connected it operates the relay test set to test the main breaker and relays so that we can be sure that they will operate mechanically under electrical overload.

Previously we either had to drill any holes we needed by hand and work with flashlights and test our relays with the actual breaker blocked because our power to our relay test was shut off when the main breaker opened.

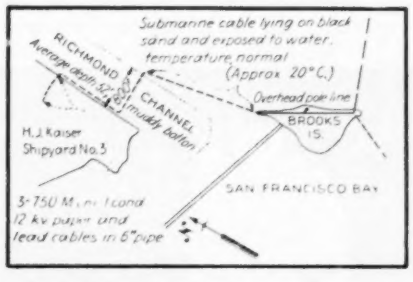
The two primary leads have spring hooks to clip over the disconnecting switch lugs after the disconnecting switch has been opened.

Temperature Rise Tests on Submarine Cable

By G. LESLIE HILL*,
Ass't. Engineer, Bureau of Tests & Inspection, Pacific Gas & Electric Co., Emeryville, Calif.

Concern as to the temperature of conductors in a heavily loaded submarine cable feeding a shipyard was felt by Pacific Gas & Electric Co. because of the fact that part of it was known to be buried in mud. This led to an interesting test which indicated an appreciable though not dangerous rise in temperature. Further, the tests showed that temperature of submarine cables that may be buried in mud cannot be taken for granted.

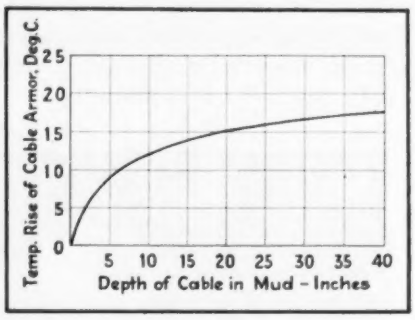
The particular section of the 500,000-cir. mil, three-conductor, 12-kv. cable in question was an 800-ft. length crossing a ship channel as shown by the accompanying sketch. Tests were made with the aid of a diver, an assistant, the regular equipment on a barge, and an attending launch and crew. The diver located the cable in the channel bottom by walking slowly in the mud until he came upon a warm spot. Then he would probe with a 5-ft. wood rod until he located the armor of the cable. A bare copper-constantan thermocouple was flattened and placed on the bottom of the wood rod, the rubber covered leads running back along the rod and up to the barge. The bay waters made an excellent constant-temperature cold


Submarine cable lying on black sand and exposed to water, temperature normal (Approx 20°C.)
RICHMOND
Average depth 50 ft.
CHANNEL
Muddy bottom
Overhead power line
BROOKS IS.
H. J. Kaiser Shipyard No. 3
SAN FRANCISCO BAY
3-750 M. cm. 1 cond. 12 kv paper and lead cables in 6" pipe

PLAN VIEW of submarine cable crossing under temperature investigation

junction bath alongside the barge The diver was cautioned to make a hole in the mud no larger than the wood rod so that water could not fill the hole and cool the thermocouple.

The accompanying curve shows the temperature rise of the cable armor for different depths of the cable in the mud. Values are quite consistent when it is considered that the diver estimated the depth of mud by notches on the rod and communicated the information to the recorder on the barge by his telephone. A total of sixteen readings were taken on the armor of the cable across the 800-ft. channel. Maximum temperatures found was 34.5 deg. C. For comparison, readings were also taken on the lead sheaths of the three 750,000-cir. mil, single-conductor cables in a 6-in. pipe passing through the shipyard. Maximum temperatures obtained here was 39 deg. C.



TEST RESULTS showing temperature rise of cable armor for different depths in mud; 3-cond., 500 Mcm. round 12/32-in. rubber insulated, jute filler, ⅛-in. jute belt, No. 4 galvanized steel armor. Overall diameter 4.125 in.

It took two days to cover the work, the readings being taken over a 3- to 4-hour period in the middle of each day, during which the load on the cable was quite steady at 470 to 500 amp.

Conclusions drawn from those tests are that the thermal resistivity of the mud appears to be a function of the depth below the bottom and that the temperature rise of the armor warrants consideration when operating old submarine cables and also when selecting new cable. The maximum temperature rise of the armor was found to be 17.5 deg. C. at the location of maximum depth in the mud. The maximum conductor temperature was then calculated to be 57.5 deg. C., which is considered to be within a safe operating temperature for this cable. It was of particular interest that the diver noted the mud surrounding the cable to be dry and hard to penetrate with his probe. Tests were conducted by the author and D. G. Kilgour, East Bay division, Pacific Gas & Electric Co.

* Asst't. Engineer, Bureau of Tests & Inspection.

Adjustable Racks Provide Anodizing Economies

Time required to load work for anodizing almost halved, substantial savings made in electric current, a far greater utilization of the available anodizing tanks permitted by orderly arrangement of parts to be treated—these are the outstanding economies obtained by use of adjustable racks at The Glenn L. Martin Co., Baltimore, Maryland. The racks were designed by employees in the finishing and plating department and replaced spring hangers for all tubes, formed parts and heavy gage flat work.

FIG. 1—Single-post anodizing rack; in foreground parts are being unloaded; in background fully loaded racks have parts criss-crossed

There are two basic types of rack, with each being made in several sizes so that by using them singly or in combination practically every size and type of part can be handled. The first type of racks (Fig. 1) consists of an aluminum alloy center post with a frame at the bottom on which parts can be stacked around the center post in log cabin manner and a pressure plate at the top to hold the racked work in place. The top edges of the bottom frame are toothed to keep the work from slipping, and the pressure plate is adjustable and held in place by a spring and pin inserted in holes in the center post. The top of the center post is in the form of a hook to permit easy handling with an overhead conveyor. Two racks can be used to hold long parts.

The second type of rack (Fig. 2) has two posts with a fixed channel section separating them at the bottom and a moveable similar section at the top. Top edges of the lower section and bottom edges of the top section are toothed to prevent slipping. Work is loaded on the bottom section and the top clamped down to hold it in place similarly to the single-post racks. In loading large parts which would cover each other such as large corrugated sheet, smaller parts are used as spacers, thus utilizing the solutions to the utmost and avoiding to a large extent their waste on handling equipment.

The new racks are both simple and durable and provide a sure and positive electrical contact. Where the former spring hangers had to be cleaned after each usage and soon lost their temper and springiness, the new racks have an almost indefinite life, with only the bottom frame having to be cleaned after usage. Since this frame is of straight rigid metal construction, it is easily cleaned and unaffected by the cleaning bath.

FIG. 2—Two-post anodizing racks. Length of parts requires use of two racks. Small parts serve as spacers between the longer parts

•

Dry-Type Transformers: Operating Experience

Performance of "Class B" insulated dry-type transformers of a modern design and in sizes up to 4,000 kva. and for voltages up to and including 15,000 was outlined by W. W. Satterlee, Transformer Engineer of Westinghouse Electric & Manufacturing Co., Sharon, Pa., in a paper presented at a recent meeting of International Association of Electrical Inspectors in Albany, N. Y.

Many transformers of this dry-type design have been in continuous operation for more than seven years. Today, over 2,000 transformers are in service totaling approximately 1,000,000 kva. Never has a breakdown of the winding insulation occurred in any of these transformers which could be directly attributed to an excessive winding temperature, an accumulation of dirt, the effects of condensation or operation in a humid atmosphere.

With 2,000 transformers in operation, four transformers have failed in service. It is of interest to note the cause of these failures, the resulting damage to the windings of the transformers and what was necessary to put the transformers back into service.

A 600-kva., three-phase, 6,900-volt, dry-type transformer flashed over as a result of a severe lightning surge. The voltage impressed on the high voltage winding was estimated to be in excess of 100 kv. Connected directly to the secondary of a 45,000-kva. bank of power transformers, this dry-type transformer had no lightning protection of any kind or no overcurrent protection between it and the power transformer bank

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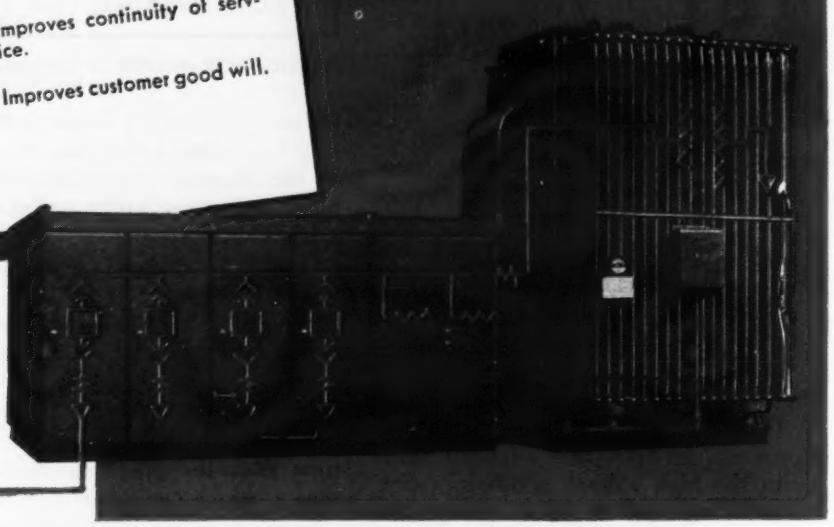
Now afforded by G-E master unit substations

WHAT IT IS:

This is a proved-in-service feature that assures improved fault protection for distribution feeders. "Fault-selective" feeder protection* offers the following advantages over conventional methods:

- ✓ Disconnects branch circuits only when **permanently** faulted.
- ✓ Reduces number of fuse blowings.
- ✓ Reduces area affected by outages.
- ✓ Reduces duration of outages.
- ✓ Reduces number of service calls.
- ✓ Reduces operating cost.
- ✓ Improves continuity of service.
- ✓ Improves customer good will.

*Optional



HOW IT WORKS:

TEMPORARY FAULTS

In the event of a temporary fault at any point on the feeder or branch circuits, the feeder circuit breaker in the unit substation trips instantaneously and recloses in a fraction of a second. This breaker opening takes place before the fuse, which protects the faulted branch circuit or sectionalized portion of the feeder, can blow. Thus, *service is restored to all customers* after a momentary interruption of only a few cycles.

SUSTAINED FAULTS

In the case of a sustained fault, such as a branch-circuit conductor coming down, the feeder circuit breaker instantaneously trips and recloses as before, thus checking to determine whether the fault was temporary. The persisting fault causes the instantaneous trip to be blocked and the time-overcurrent relays to be put into operation.

The first trip is fast, but the second is slow, delayed enough to let the fuse which protects the faulted branch circuit blow before the feeder circuit breaker opens the second time. The blowing of the fuse disconnects the faulted branch, and thus prevents the second opening of the circuit breaker.

"Fault-selective" feeder protection is only one of the extra advantages offered by General Electric master unit substations. Ask your G-E representative to give you further details. *General Electric Company, Schenectady 5, N. Y.*

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GENERAL ELECTRIC

feeding it. The high voltage winding was severly damaged; the line leads and a considerable portion of the winding were fused because the system breaker on the 150,000-volt line feeding the power transformer permitted arcing for a considerable period of time. It is interesting to know that neither an explosion nor a fire occurred. It was necessary to replace the windings.

A 1,000-kva., three-phase, 13,800-volt, dry-type transformer was temporarily put out of service because of a lightning surge. However, in this case, flashover occurred across two plain rectangular porcelain insulators which were used to support the high-voltage leads. As a secondary result, a small arc occurred at one point between the two outer turns of the top high voltage coil section of one phase. The turn insulation was only slightly damaged. Permanent repair of the winding was made and the transformer was put back into service within two hours after the failure. Later, the rectangular-shaped porcelain insulators were replaced with round corrugated insulators in line with present-day practice.

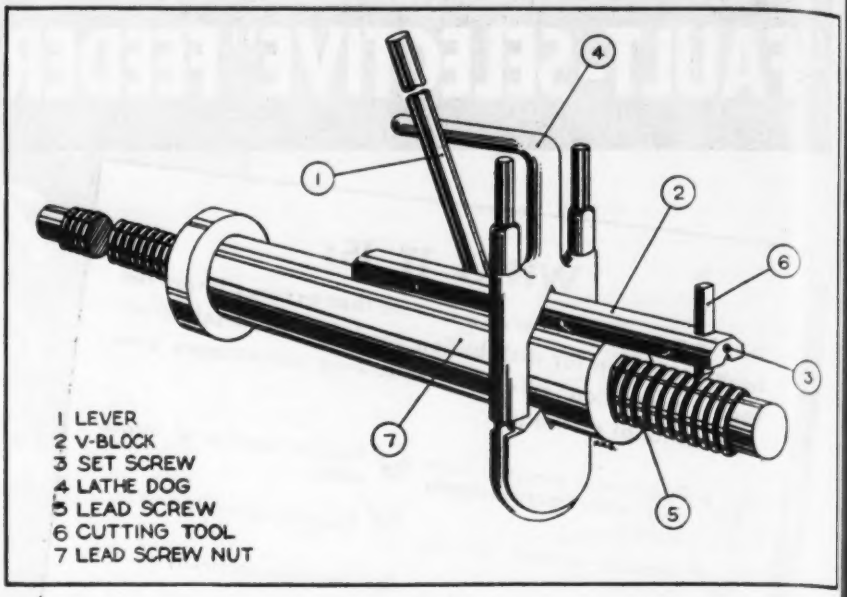
Two other dry-type transformers failed after short periods of service. One failure was caused by a short-circuit between two adjacent turns in the high voltage winding, apparently the result of a poor joint in the copper which punctured the insulation. Repair was effected easily and quickly. The other transformer outage was caused by the flashover of a porcelain lead support which may have been due to an excessive accumulation of dirt. The only repair necessary was to replace the porcelain lead support.

•

Repair Damaged Threads on Machine Lead Screws

For reconditioning the damaged threads on lead screws on exciter rheostats and breaker-tank mechanisms, deformed either by accident or normal wear, a quick and easy method has been devised by Clifton Roberson, a maintenance man at General Electric's Erie Works.

In this method a lathe dog (4) clamps a V-block (2) machined to hold a cutting tool (6) to the lead-screw nut (7). In effect the nut becomes a die with a single point cutting tool when a tool bit, ground to fit the thread, is inserted in the V-block and locked with a setscrew (3). The tool will clean burrs and bumps preceding the nut, which is held stationary by a long lever (1), while the screw (5) is driven by a lathe.



SET-UP FOR REPAIR of machine lead screw

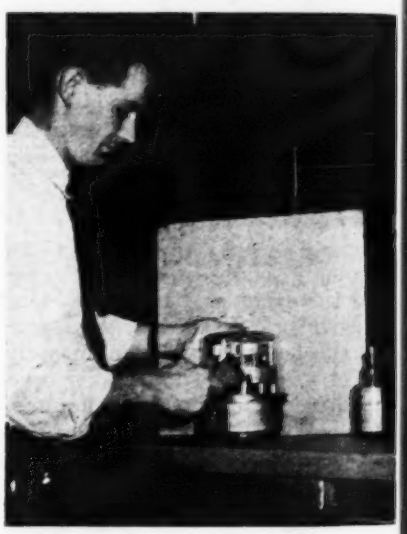
Since few shops are equipped to machine such long pieces, the usual procedure is to file off the deformities. This involves considerably more time than the proposed method of repair, which can sometimes be performed without disassembling the screw.

•

Clean Meter Covers on Turntable

One quick and easy way to take paint off glass meter covers is to scrape it off with a razor blade as the assembled meter revolves slowly on a motor-driven turntable. The illustration shows the method in operation at the meter shop of Indianapolis Power & Light Co.

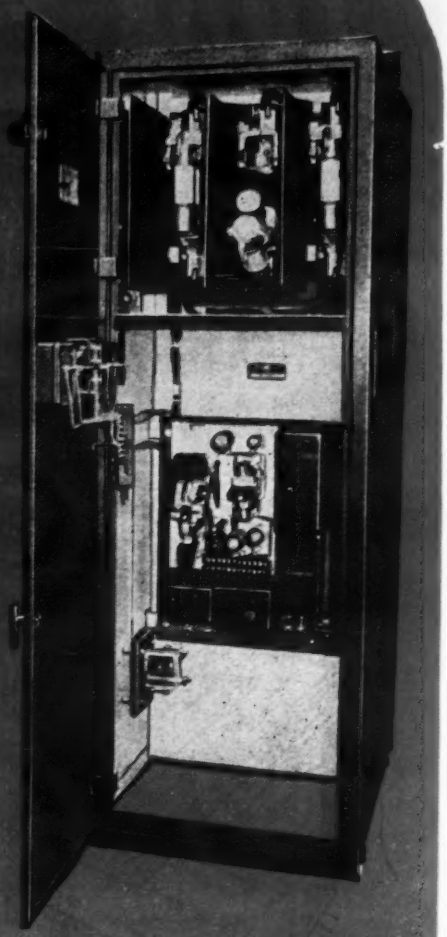
In this case a washing machine gear box, belt-driven by a fractional horsepower motor is mounted below the work bench. Low speed shaft of the gear box projects through the bench top. To it is fastened a flat circular plate or turntable to which in turn is bolted a conventional meter socket. The completely assembled meter, paint-spattered glass cover and all is placed in the socket and is turned at around 120 rpm. by the mechanism. "Window cleaner" sprayed on the cover as it turns, helps along the removal of paint and dirt. Note that the operator holds a cloth in his left hand, wiping the cover as it turns clockwise. Of course safety requires that the razor blade be held in a handle of some sort as can be observed in the illustration.



PAINT-SPATTERED glass meter cover being scraped clean with razor blade as it revolves on power turntable

The Indianapolis utility, which patterned their turntable after one attributed to the Los Angeles Bureau of Power & Light, reports that with the turntable one man can clean about 25 meter covers in a couple of hours whereas it was an all day job to screw nut (7). In effect the nut be-

HOW LIMITAMP CONTROL PROTECTS YOUR MOTOR



1/2-CYCLE OPERATION clears high-voltage fault currents before they can do harm

LIMITAMP control, for use with squirrel-cage, synchronous, and wound-rotor motors, provides fast, positive short-circuit protection so necessary for safe operation at high voltages.

Your Motor Is Protected by These Three Limitamp Features

1. **½-cycle Operation**—By means of Type EJ-2 fuses, a rise in current due to a short-circuit is cut off in less than one-quarter cycle, and cleared in less than one-half cycle—long before fault currents can harm your motor.

2. **Efficient Overload Relays**—Accurately calibrated against actual motor characteristics, isothermic overload relays protect your motor from overheating due to sustained overloads, locked rotor, or single-phasing.

3. **Undervoltage Protection**—When there is a low voltage or when power fails, the control *takes the motor off the line,* and the motor will not restart on return of power.

Noiseless in Operation—Limitamp control works silently. Operators are not startled by any part of its operation. Even when a fuse blows, there is no noise. There's only a plainly visible bulge in the end of the fuse.

A Co-ordinated Control

Air-break contactors, designed to meet the most severe requirements of high-voltage motor-control service, are co-ordinated with the EJ-2 fuses. Because the full short never passes through these contactors, it is possible for them to have a mechanical life of several million operations, and contact-tip life many times that of conventional devices. Bulletin GEA-4247 gives a well-illustrated description of all the features that make Limitamp control tops in the field of high-voltage control. Ask our local office for a copy, or send the coupon direct to General Electric Company, Schenectady 5, N. Y.

On voltages up to 4200 volts, the interrupting capacity of Limitamp control makes it the logical answer for any application where high-voltage fault currents are encountered.

General Electric, Section 676-163
Schenectady 5, N. Y.

I'd like more information about your Limitamp control. Please send me Bulletin GEA-4247.

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Company .....

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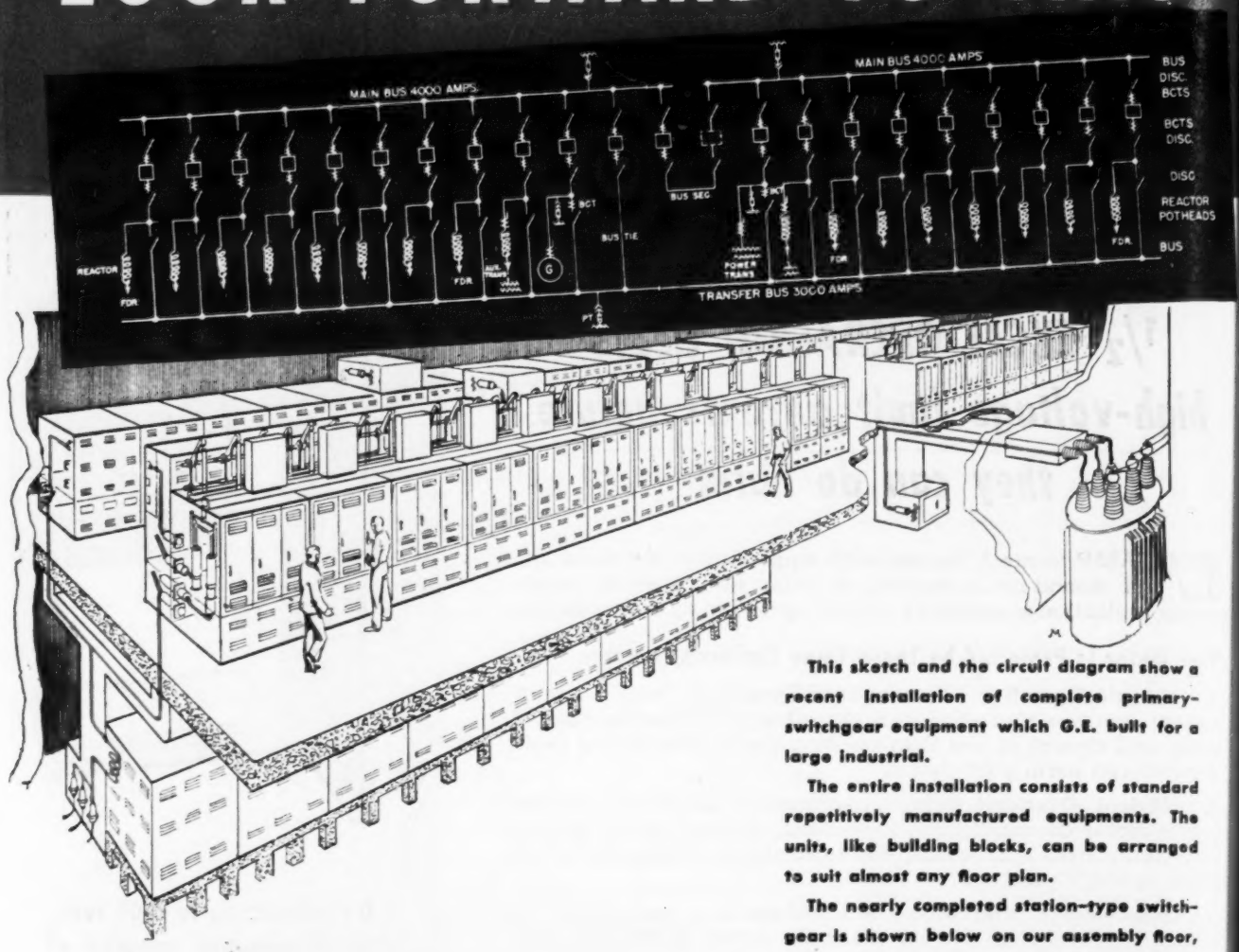
.....

Buy all the BONDS you can—and *keep all you buy*

GENERAL ELECTRIC

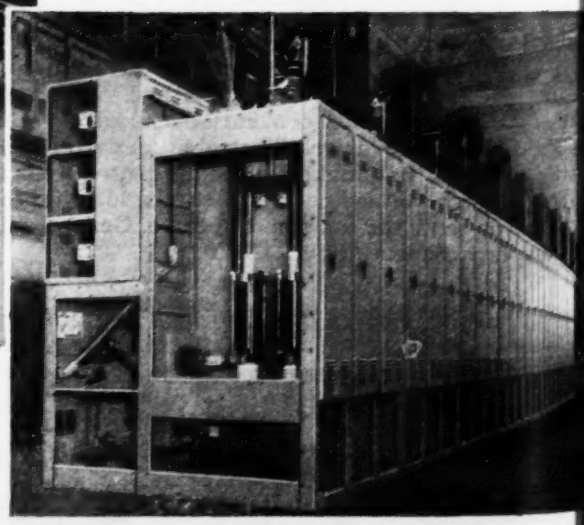
LOOK FORWARD TO THIS



This sketch and the circuit diagram show a recent installation of complete primary-switchgear equipment which G.E. built for a large industrial.

The entire installation consists of standard repetitively manufactured equipments. The units, like building blocks, can be arranged to suit almost any floor plan.

The nearly completed station-type switchgear is shown below on our assembly floor, where we duplicate the actual installation floor plan and test all such assemblies to insure proper co-ordination. The complete equipment is designed with accent on accessibility of all parts for easy maintenance, and must be right both electrically and mechanically before it is shipped.



Metal-enclosed, transfer-bus compartments (left) and FH cubicles (right) in final stages of construction. These equipments contain everything necessary for proper operation—require only metal-enclosed bus-run connections to related equipments and secondary connections to the metering-and-control center.

BUY WAR BONDS

TYPE OF SWITCHGEAR

It enables you to apply your most advanced thinking and do it at the lowest investment cost—

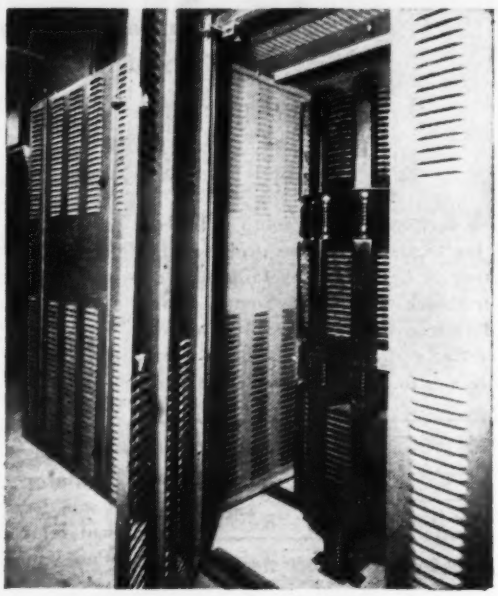
...for a station or even a whole system

THIS metal-enclosed primary switchgear, for circuits up to 33 kv, and with interrupting ratings up to 2,500,000 kva, is so designed that it can be factory-assembled in many standard combinations.

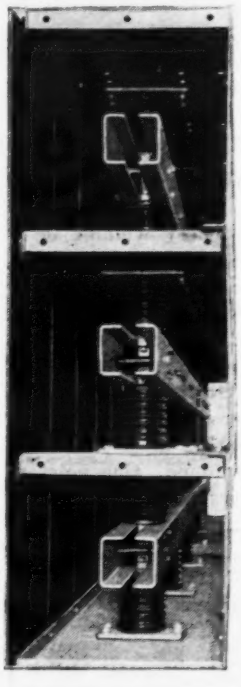
Its versatility enables you to meet almost any circuit arrangement and functional requirement with standard, repetitively manufactured equipment.

The same versatility permits you to make the best possible use of your available floor space. The basic units of equipment can be assembled in such a way, and the equipments so grouped and located, that, usually, major reconstruction or an addition to the building is not necessary. On new construction many purchasers, stimulated by the variety of factory-assembled combinations available, have made important savings by designing the building to fit an ideal arrangement of equipments.

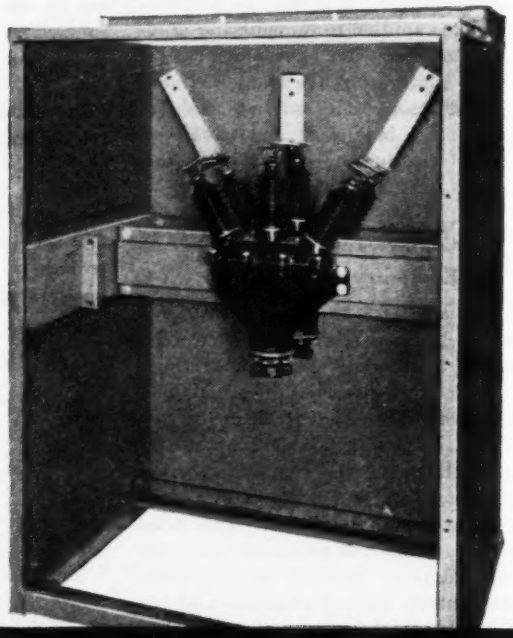
Complete, standard G-E switchgear equipments are available for the high-voltage primary circuits and the low-voltage auxiliary circuits. Whether you are planning new construction or want to modernize an installation, ask your G-E representative how standard switchgear equipments can help you to provide better circuit protection, regulation, relaying, or control. *General Electric Company, Schenectady 5, New York.*



Metal-enclosed feeder-reactor compartments



Metal-enclosed, three-phase bus runs



Metal-enclosed cable-entrance compartment with three-phase pothead

PACKAGED SWITCHGEAR

GENERAL ELECTRIC

FOUR USES OF A MULTIMETER IN RELAY TESTING

By H. L. GOODRIDGE, Relay Supervisor, New England Power Service Co., Melrose, Mass.

A multimeter (volt-ohm-ammeter) using an instrument with a sensitivity of 1,000 ohms per volt has proven to be a useful tool in shooting troubles on relays and their associated circuits

Test Contacts

On a carrier relaying setup a pull-out on a fault external to the protected line appeared to be caused by failu of carrier to block. All relays involved were tested by conventional methods, as were the carrier radio sets. No cause of the trouble was found. Nevertheless, the carrier starting current was suspected. The relay was disconnected and the ohmmeter was connected across its contacts. Current was applied to the coil and gradually increased. At approximately 2½ times tap plug rating, the ohmmeter shot up to 1,000 ohms. This strengthened the suspicion and investigation proved that the relay was improperly balanced mechanically, causing a vibration point.

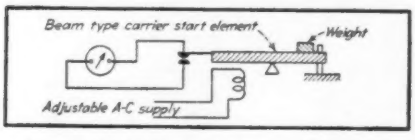


FIG. 1—Detects contact troubles

Contact Testing With Equipment in Service

In another case involving directional ground relays fed from a Y-broken delta potential transformer, a potential transfer relay was suspected. Normal procedure would have been to clean the contacts and hope this would eliminate the trouble. However, the contacts were not easily accessible, and it was desirable to determine their condition. The ohmmeter was connected across the normally closed contacts without disconnecting. Some contacts showed resistances of several thousand ohms, and all showed at least one ohm above the resistance of a clean contact. From this experience it was decided that this was the wrong type of relay for the purpose since there was no wiping action on the contacts.

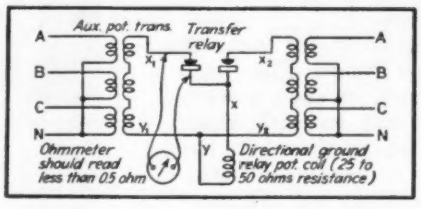


FIG. 2—Test made with equipment connected and in service

Check C.T. Secondary

The ohmmeter is also useful in locating an open circuit or a high resistance contact in the secondary winding of a current transformer. To make this test the current transformer must be disconnected and the resistance of each phase to neutral checked. Should the resistance of one phase be appreciably higher than the other two the circuit is rechecked at the switchboard terminals. By checking one section of wiring at a time, the trouble is quickly found. One point to be remembered is that the balancing auto-transformers at the switchboard have a very low resistance, and therefore, should be disconnected from the circuit and the wiring from the auto-transformers to the relays checked separately.

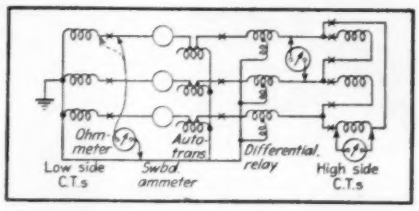


FIG. 3—Disconnect at points marked X and test both sides to neutral with ohmmeter. When delta connected current transformers are used, check phase to phase or phase to ground

Check Relay Coils

In checking current in the different coils of a differential relay, one phase checked considerably lower than the other two. Current in the restraining coils appeared to be normal. The relay was taken out of service and its current coils checked with the ohmmeter. On the phase which had the low reading, a slightly loose tap plug (¼ turn) caused a one ohm increase in resistance.

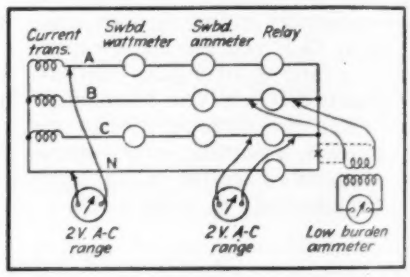


FIG. 4—Checking current transformer circuit while in service

A 2-volt a.c. scale was added for the purpose of checking voltage drops in the current transformer circuit. This scale is also useful in checking open or high resistance contacts without taking the equipment out of service. By checking voltage drop across each relay, an indication of current flowing in the relay is obtained without the difficulty of cutting in an ammeter.

FLAMENOL* CORDS

(Thermo-plastic Insulation and Jacket)

For Industrial Use

Here's the ideal heavy-duty cord to use on portable tools for utility maintenance work. It is ideal also for use on tools in industrial plants, machine shops, mines, service stations, garages, packing houses, etc. It is available with two or three conductors.

This Flamenol Cord is mechanically strong, easy to handle, light in weight and flexible. Both the insulation and jacket of the cord are made of long-life, thermo-plastic compounds. These compounds are resistant to water, oils, acids, alkalies and sunlight.

The same physical and electrical tests made on Flamenol Building Wire are made on this cord. In addition, special tests are made which simulate tough working conditions. Flamenol Cord can be depended upon, without question, for trouble-free service under severe operating conditions.

Type SN for general purpose wiring

Type SNW for wiring in wet locations

FLAMENOL BUILDING WIRE

Flamenol small diameter, thermo-plastic building wire is ideal for new wiring, rewiring and maintenance wiring. Flamenol wire is particularly ideal for rewiring because its small diameter permits more copper to be placed in conduits. It is available in sizes 14 to 2,000,000 CM, and can be used for feeders, branch circuits or special wiring.

*Reg. U.S. Pat. Off.

FOR FURTHER INFORMATION on Flamenol Portable Cords or Flamenol Building Wire, see the nearest G-E Merchandise Distributor or mail the coupon.

General Electric Co.
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☐ Flamenol Cords ☐ Flamenol Building Wire

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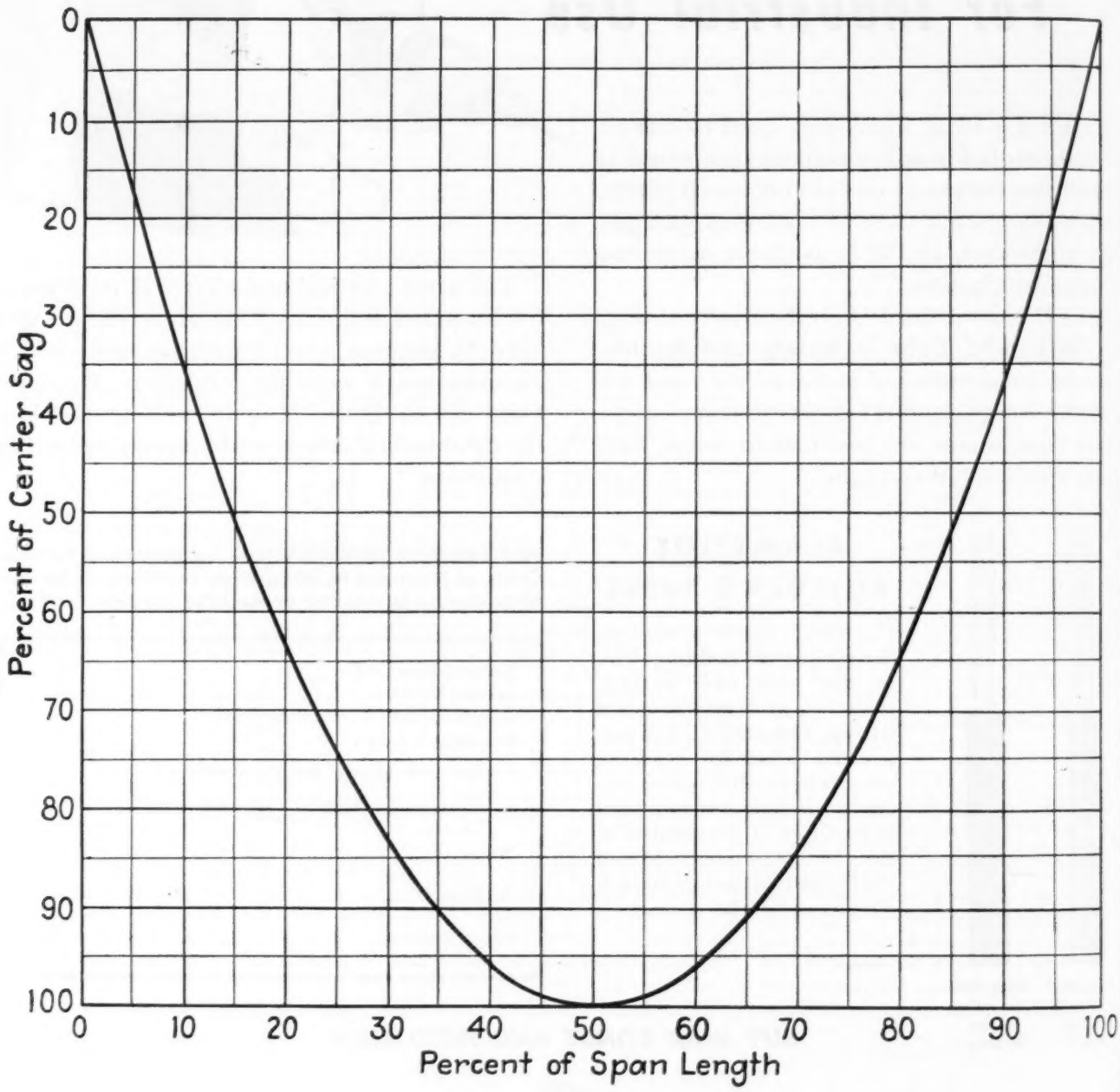
BUY WAR BONDS AND HOLD THEM

GENERAL ELECTRIC

CATENARY CURVE ORDINATES

Curve gives approximate values of sag at all points on the catenary curve expressed in percent of the center sag. The error is negligible for all spans in which the center sag is less than 10 percent of the span length. This curve is adapted from recently published Discussion Handbook 39, National Electrical Safety Code, part 2, National Bureau of Standards and is designated as Miscellaneous Publication M176, chart 3, for separate procurement.

CATENARY CURVE



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by Revere

Brass, whether in the form of plate, sheet, strip, rod, bar, tube, pipe or special shapes, can be no better than the original casting from which those products are fabricated.

That is why Revere exercises the most careful control over this basic process. That control begins in the laboratory and is carried through to the finished product. In many cases Revere engineers have worked out original methods. Through analyses of test specimens from every melt, through detailed supervision of workmen, and through careful training of those workmen to the meticulous Revere standards of craftsmanship, we and you are assured that every casting is absolutely right and will produce sound products for you.

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COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue
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1. *Charging the furnace*
2. *Taking test sample of melt*
3. *Pouring a sound slab*
4. *Sawing gate off cake*
5. *Slabs ready for rolling*

WATTHOUR METER CONNECTIONS FOR TOTALIZING POLYPHASE CIRCUITS

By H. W. BRUCE, Engineer, Department of Water and Power, City of Los Angeles, Calif.

Diagrams adapted from electrical standards of the Department of Water and Power, City of Los Angeles, show connections for watthour meters through test switch and test block to totalize energy consumption on the indicated circuits. Plus (+) sign indicates polarity.

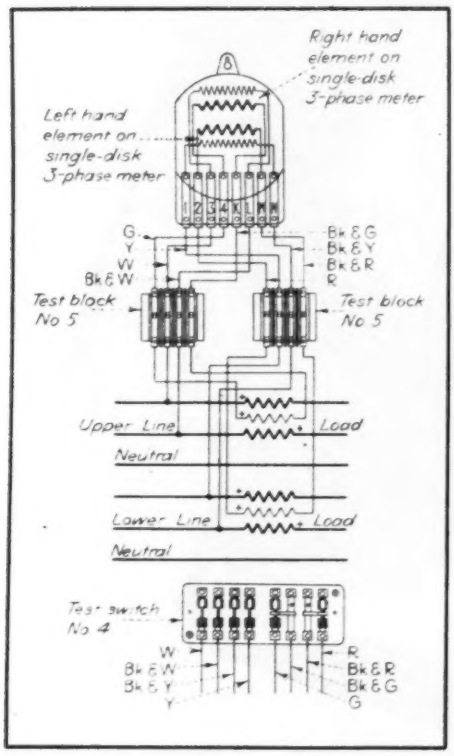


FIG. 1—Connections for 3-phase, 2-element single-disk, watthour meter for totalizing two 3-wire circuits, with test block and switch

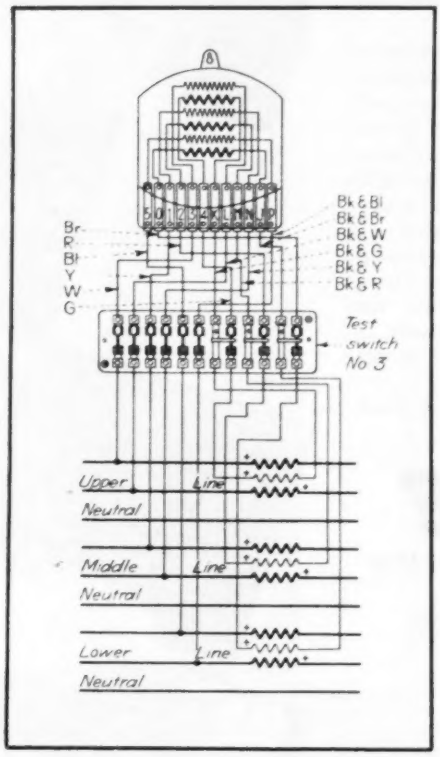


FIG. 2—Connections for 3-phase, 3-element watthour meter (Westinghouse) for totalizing three 3-wire lighting circuits

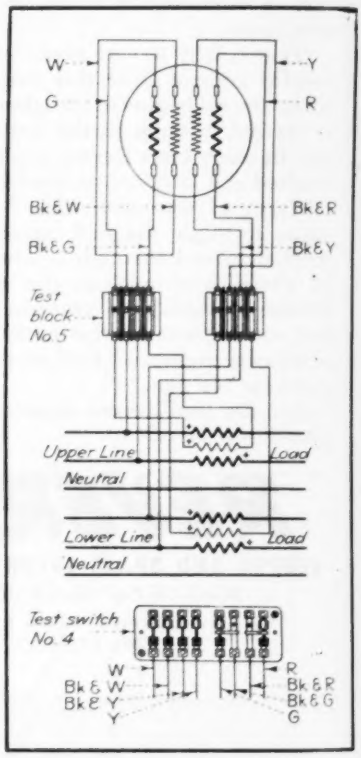
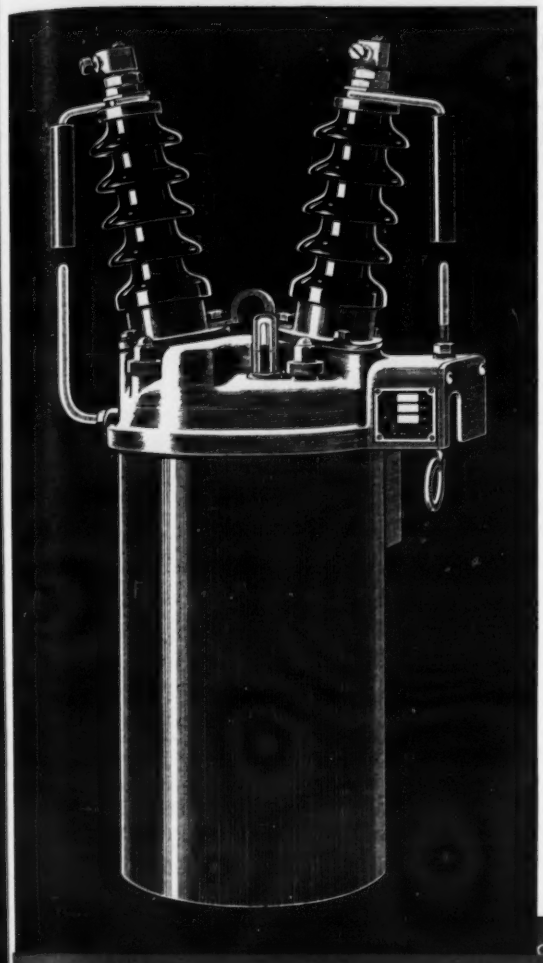


FIG. 3—Connections for 2-element, single-disk watthour meter (all makes, for S base) for totalizing two 3-wire circuits

Color Legend

Bk. for Black	Br. for Brown	W. for White
Bl. for Blue	G. for Green	Y. for Yellow
	R. for Red	



This is the way KYLE Automatic Oil Circuit Reclosers Operate

- **To Decrease Outages**
- **To Reduce Maintenance**
- **To Increase Continuity of Service**

Rural distribution systems with their long lines and small loads scattered over large areas depend, for their economical operation, on low cost of installation, minimum cost of maintenance, and maximum continuity of service.

Kyle Automatic Oil Circuit Reclosers provide the perfect protection for such lines. This Recloser has the advantages of minimum time delay opening on the first and second operations to clear all transient faults on the protected sector. It also gives greater time delay opening on the third and fourth operations to allow the blowing of a sectionalizing or transformer fuse to isolate a permanent fault without locking out the Recloser.

Thus, the Kyle Recloser permits the clearing of 85% of all faults which occur on rural systems and restores service completely as soon as they are cleared. It isolates the permanent faults to the smallest possible localities.

This ability of Kyle Automatic Oil Circuit Reclosers to coordinate with fuse links greatly decreases the number of outages, eliminates countless service trips, reduces maintenance costs and provides the greatest possible continuity of service.

TIME CURRENT VALUES OF KYLE RECLOSER OPERATION

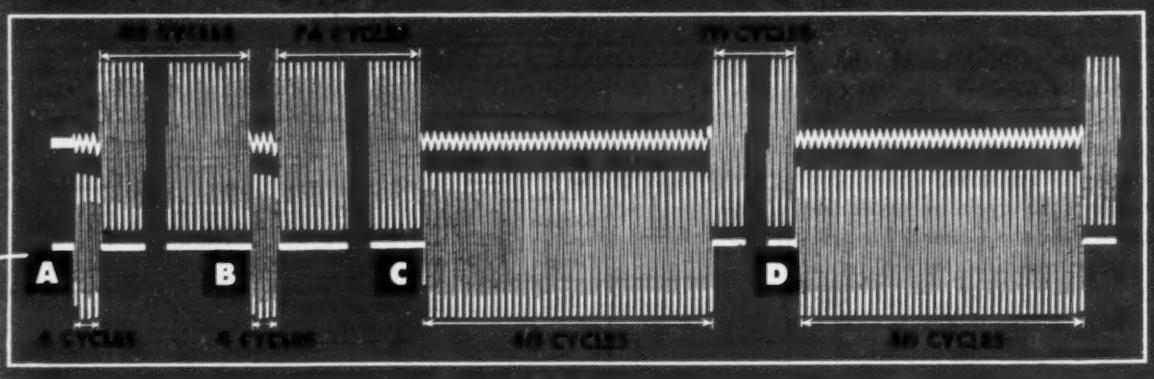
This oscillogram gives a graphic picture of the time current values obtained in a single interruption of a 5 Ampere Type "H" Kyle Automatic Oil Circuit Recloser taken at 2400 volts with a current of slightly over 20 amperes and a power factor of 82.5.

A FIRST OPENING: Time required to open: 4 cycles; time delay before reclosing: 52 cycles.

B SECOND OPENING: Time required to open: 4 cycles; time delay before reclosing: 74 cycles.

C THIRD OPENING: Time required to open: 40 cycles; time delay before reclosing: 70 cycles.

D FOURTH OPENING: Time required to open: 40 cycles. Recloser locks out.



Ask your Line Material Representative to give you full information on the specific application of Kyle Automatic Oil Circuit Reclosers to your lines.

MADE BY KYLE CORPORATION SOUTH MILWAUKEE WISCONSIN

KYLE Circuit Reclosers are Designed and Manufactured for LINE MATERIAL COMPANY MILWAUKEE WISCONSIN

Polyethylene Used as Coaxial Insulation

Properties of electrical grade of polyethylene fit the material for use as an insulation on coaxial cable, vital to radio equipment today, and essential to television tomorrow. These properties listed in the table plus the fact that it is unaffected by acids, ground moisture (not necessary to braid over the insulation) and the fact that it does not support fungus growth has made it applicable for use on Army assault wire.

Its use here demonstrated these advantages:

1. The light weight of the insulation, accruing from its specific gravity and the practicability of thin wall insulation, makes it possible to carry larger size reels of wire, or the same size reels with greater ease and rapidity.

2. Electrical properties of the material, together with its resistance to the effects of moisture, oil and sunlight, makes possible greater distance between relaying stations.

3. Electrical properties are not materially affected by changing weather conditions.

This material developed by the Carbide & Carbon Chemicals Corp. in collaboration with the Linde Air Products Co., can be processed by methods now employed for older types of thermoplastic materials. It can also be extruded, molded, fabricated into sheets and film, and coated on cloth. Other applications are: washers, gaskets and tubing.

Properties of Standard Electrical Grade Polyethylene Resin

Specific Heat: 18–40 deg. C.	0.53
Heat and Combustion: Cal. g.$^{-1}$	11,100±15
Softening Temperature: deg. C.	108–112
Moisture Diffusion Constant: Mg.hr.$^{-1}$ Cm.$^{-2}$ at 30 deg. C.	0.028
Water Absorption: Percent Wt. Gain, 24 hr. at 25 deg. C.	0.01
Thermal Conductivity: Cal.cm.$^{-1}$ Sec.$^{-1}$ deg. C.$^{-1}$	
Range 0–15 deg. C.	0.81×10^{-4}
25–40 deg. C.	0.62×10^{-4}
Thermal Diffusivity: Cm.^{2} Sec.$^{-1}$	
0–15 deg. C.	1.66×10^{-4}
15–25 deg. C.	Value Changing
25–40 deg. C.	1.37×10^{-4}
Volatility, Percent Wt. Loss: 72 hr. at 82 deg. C. in air	0.0

Thermal Expansion Characteristics: Cubical Coefficient, deg. C.$^{-1} \times 10^{6}$	
−35 deg. C.	300
−20	410
0	—
10	550
20	710
25	745
40	870
60	1,010
80	1,210
100	1,500
110	1,530
115	750
115 to 150	750
150	750
Power Factor: 25 deg. C.	
1 Mc.	30×10^{-4}
50 Mc.	30×10^{-4}
Dielectric Constant: 25 deg. C.	
1 Mc.	2.3
50 Mc.	2.29
Direct Current Resistivity: Megohms-cm. (25 deg. C.)	10^{9}
Surface Resistivity: Ohms	2×10^{13}
Dielectric Strength: Volts. mil^{-1}	
20 deg. C. 0.075 in. Thickness	1,000–1,100
80 deg. C.	630

• • •

Cycle Recording Device for Timing HS Relays

By C. W. COGBURN
Transmission Department, Florida Power & Light Co., Fort Pierce

A cycle recording device for measuring short time intervals of one-half cycle or longer was built for use in timing all types of high speed relays. It consists of a General Electric Co. cycle recording tape machine with an auxiliary relay and several small switch parts and resistors.

Essentially, the cycle recorder as manufactured by the General Electric Co. is a tape machine, driven by a 110-volt, 60-cycle motor through suitable gears. The tape is drawn over a graphite-coated cylinder which revolves in opposite direction to the travel of the tape. An armature, hinged inside a double 1-amp., and 5-amp., 60-cycle coil, vibrates with a 60-cycle frequency response, and the free end presses against the tape, which produces a carbon tracing on the under side of the tape. This carbon tracing will be sine-wave shaped. The hinged armature travel is damped by a permanent magnet.

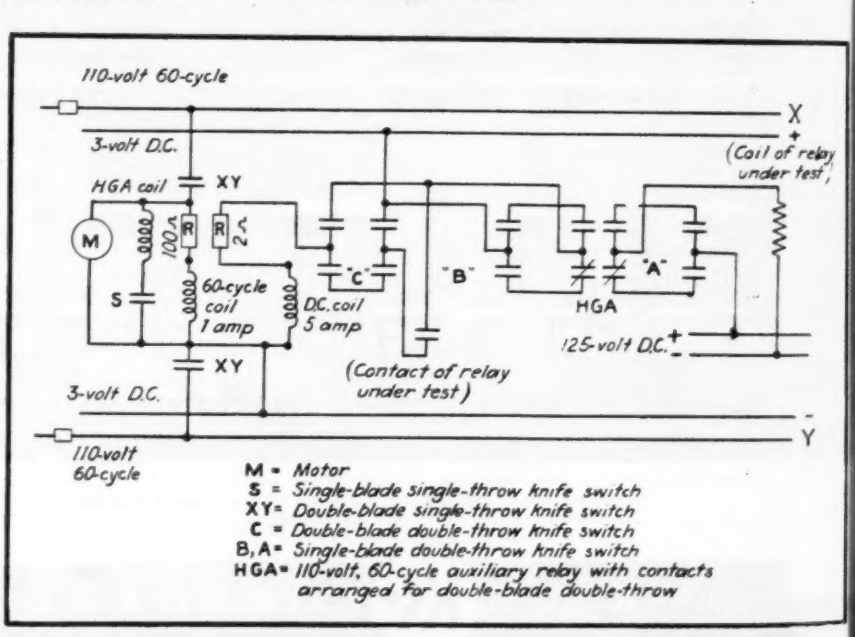
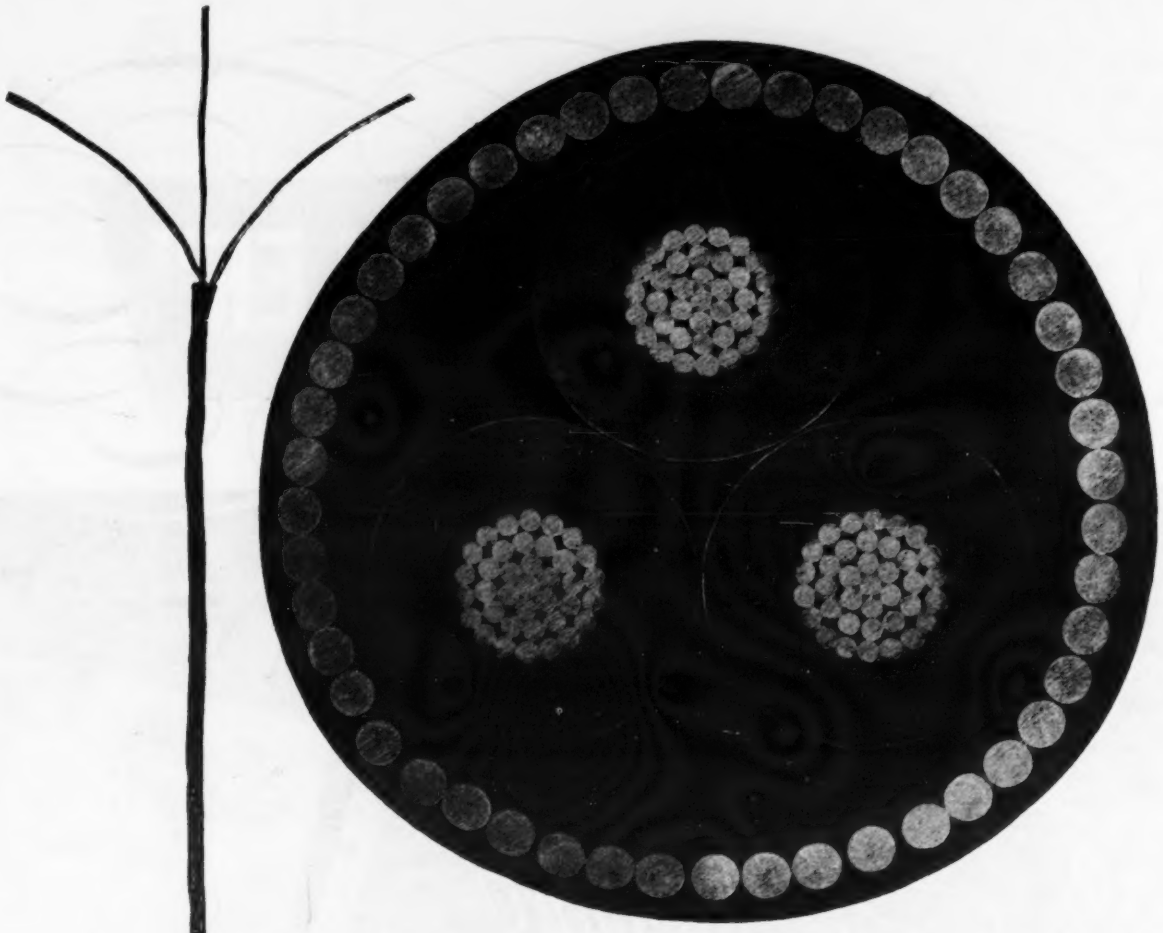


FIG. 1—Elementary diagram of timing device:
M = motor; Knife switches, S = single-blade single-throw, XY = double-blade single-throw, C = double-blade double-throw, B,A = single-blade double-throw; HGA = 110-volt, 60-cycle auxiliary relay with contacts arranged for double-blade double-throw



These three-conductor cables (shown full size) are typical of Simplex versatility and ability to design special cables to meet unusual demands. In service, the smaller is fully as important as the other. Failure of either would interfere with essential service. The larger is one of the largest submarine power cables ever made by us.

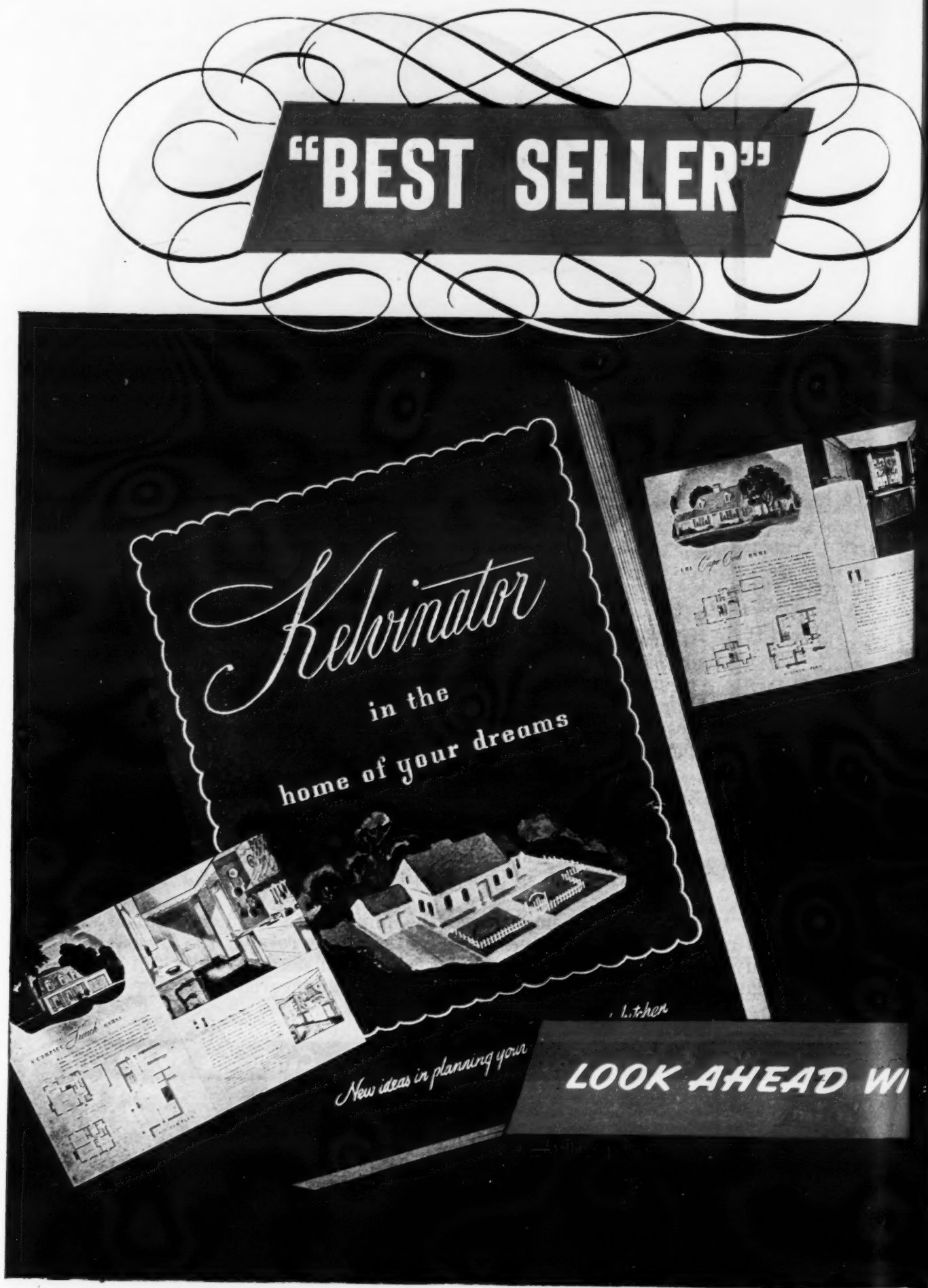
Each cable was designed after careful, thorough analysis of installation and operating conditions; each had to meet severe tests to prove its fitness. Ordinary "hand-me-down" cables would not do. Dependable service is vital in both instances and each cable is proving to be ideally suited for its work.

For many years we have emphasized the importance of fitting cables to the job. No cable is too large and none too small to receive the benefit of careful study by our cable engineers. The cables you need to carry out your postwar plans will serve you better if they are "engineered to fit the job."

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

Simplex

WIRES and CABLES


"BEST SELLER"
Kelvinator
in the
home of your dreams
New ideas in planning your
LOOK AHEAD WI

Published and furnished by Kelvinator without charge to retailers, for their use as a service to home owners, this book, "Kelvinator in the Home of Your Dreams," is now a "best seller" in every sense of the word!

The story is this . . .

Kelvinator merchandising executives have constantly studied to determine the most effective methods of pre-selling the postwar market for Kelvinator Retailers. Their aim — to make Kelvinator part of the great demand in every family for a truly modern kitchen . . . to have Kelvinator help those families plan the kitchen of their dreams.

So, Kelvinator called in six famous architects . . . had them develop and put in one book many important new ideas and principles of kitchen convenience . . . showing with dramatic illustrations how perfect *a kitchen scientifically designed around Kelvinator* can be.

Announcement of this book was made only a few months ago . . . *but already* distribution is in the second million copies!

The huge demand for "Kelvinator in the Home of Your Dreams" by home owners, present and future, proves again how accurately Kelvinator has analyzed consumer interest for its Retailers . . . how surely it is capitalizing on this consumer interest by *pre-selling* now to give Kelvinator Retailers a big "ready-to-buy" market as soon as products are available.

Another answer to "What's Ahead for Kelvinator Retailers?"... this "best seller," and the "retail-minded" thinking back of it, emphasize why retailers with the Kelvinator Franchise hold "the most valuable franchise in the Appliance Industry."

FOR APPLIANCE DISPLAY —a *new* book of modern store and appliance department layouts to help Kelvinator Retailers plan for greater sales through better display.

Kelvinator

DIVISION OF NASH-KELVINATOR CORPORATION

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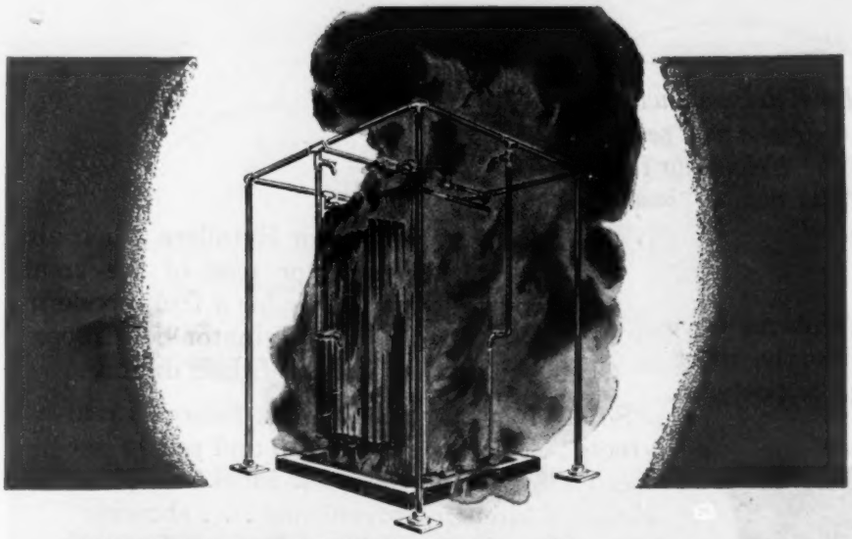
Every Sunday 4:30-5:00 P. M. EWT for the new NASH-KELVINATOR RADIO SHOW, starring the ANDREWS SISTERS — Over the entire Blue Network



SUPPOSE YOU HAD *only 11 seconds*
to extinguish a roaring transformer fire!

Impossible? Not for "Automatic" FIRE-FOG. In a recent fire test that's just what happened.

Using a standard transformer with FIRE-FOG protection, we ignited transformer oil in and around it and *permitted* the resulting fire to burn several minutes. Then it was up to FIRE-FOG to demonstrate its ability. And it did!

From FIRE-FOG nozzles misty sprays knocked the flames down, cooled the fire area, smothered the blaze and quenched the fire. *Using only a few gallons of water, the entire extinguishing performance took exactly 11 seconds!*

Listed by Underwriters' Laboratories, Inc. and approved by Factory Mutual Laboratories.

"Automatic" manufactures and installs a complete line of fire protection devices and systems for all types of fire hazards. Write for complete information.

"Automatic" SPRINKLER CORPORATION OF AMERICA
YOUNGSTOWN, OHIO . . . OFFICES IN 31 CITIES

By introducing a direct current field in the 60-cycle field, a different wave shape will be obatined.

The operating time for both pickup and dropout of the HGA auxiliary relay will be less than one-fourth of a cycle, as the contact travel was reduced to approximately one thirty-second of an inch.

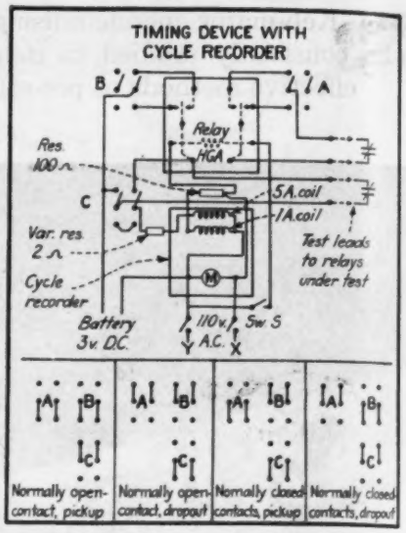


FIG. 2—Relay timing device with cycle recorder (back view). Lower part of diagram shows switch positions (front view) as set for timing a carrier current relay

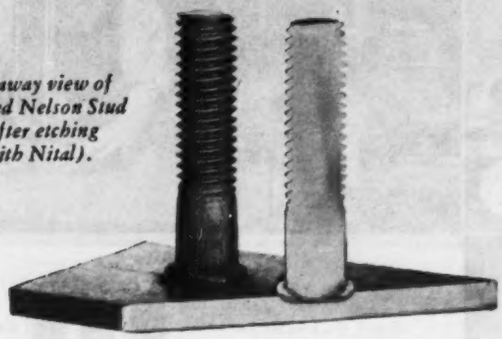
The 100-ohm resistor will limit the alternating current to about one amp.

By means of the adjustable 2-ohm resistor the deflection of the hinged armature is greatly reduced and the peaks of the 60-cycle wave are considerably flattened.

By means of the contact arrangement as shown in the elementary diagram. (Fig. 1) this direct current field can be applied to the 60 cycle field by means of "C" switch and the HGA relay contact selector switch "A". Since a relay may have either normally open or normally closed contacts for pickup or dropout, it is necessary to have some means of introducing this direct current component either at the start or at the end of the time interval.

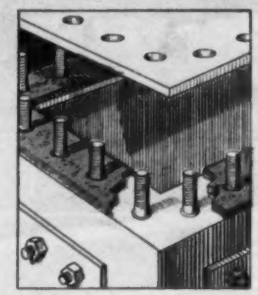
The accompanying wiring diagram (Fig. 2) shows positions of the different switches for timing a carrier current relay. In this case the interval measured for pickup at the moment the negative bias is removed from the grid of the oscillating tube of the transmitter until the relay contacts close. In cases where the coil of the relay under test is energized by 125-volt battery, the "A" switch will be in

Here are a few of the ways thousands of Nelson Stud Welders are used . . .

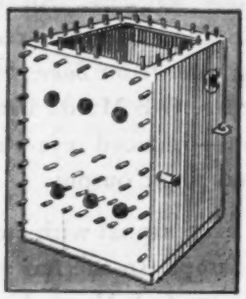


Cutaway view of welded Nelson Stud (after etching with Nital).

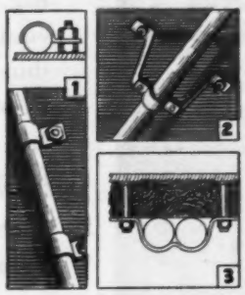
Thousands of Nelson Stud Welders are now used by more than 500 industrial plants and shipyards in applications similar to these. This process eliminates time and material consumed in hand-welding bolts, or drilling and tapping for studs. The *complete fusion* of the stud to metal is obtained *in ½ second* . . . and the resulting weld is stronger than the strength of the stud!



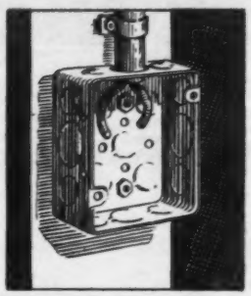
Inspection covers of all types can be secured with Nelson Studs. Eliminates drilling and tapping holes in the casing, or hand-welding studs. No leaking or loosening. Gaskets are placed over the studs and cover tightened down. Stud is welded in ½ second!



Transformers and switchboxes are now stud-welded to secure inspection covers, insulators, nameplates, conduit, etc. Electrical manufacturers find a stud end-welded to the casing saves time and material normally consumed in drilling and tapping holes. The welds are strong, leakproof, non-loosening.



Wiring, conduit, and pipe are quickly secured. Illustrated above are a few of the many methods used: 1. Securing conduit. 2. Securing pipe (single or multiple runs). 3. Securing wiring of all kinds over insulation materials.



Electrical equipment of all kinds, outlet boxes, circuit breakers, etc., can be secured without drilling or tapping metal to secure them or welding small pads. Accurate locating is easy because all Nelson Studs are pointed.

The Nelson Electric Arc Stud Welder

For complete details and catalog, write:

NELSON SPECIALTY WELDING EQUIPMENT CORPORATION

Dept. EW, 440 Peralta Ave., San Leandro, Calif.

Eastern Representative: Camden Stud Welding Corp. Dept. 122, 1416 South Sixth St., Camden, N. J.

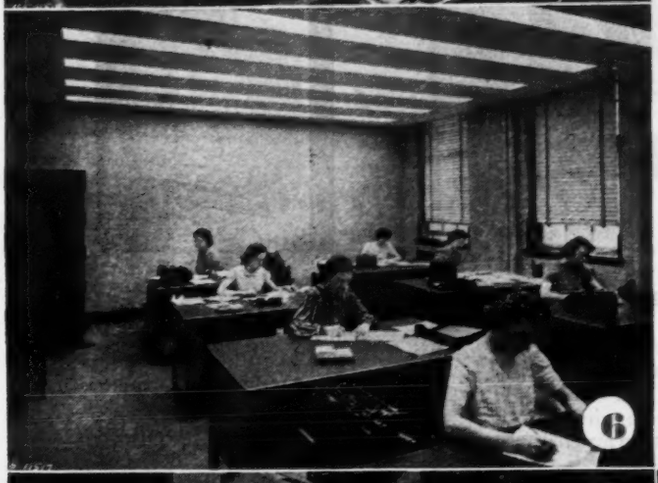
NELSON STUD WELDERS & STUDS

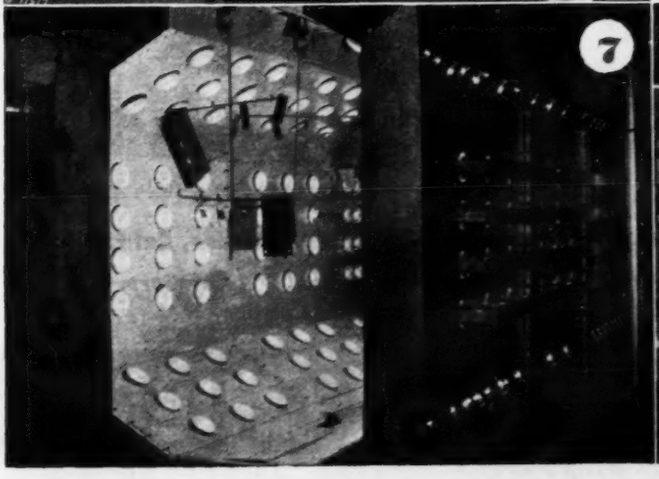
10 PROVEN IDEAS

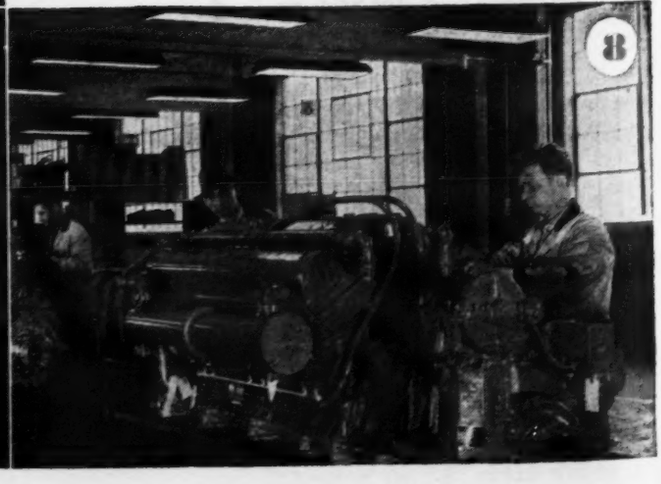
to increase plant output with G-E Mazda Lamps

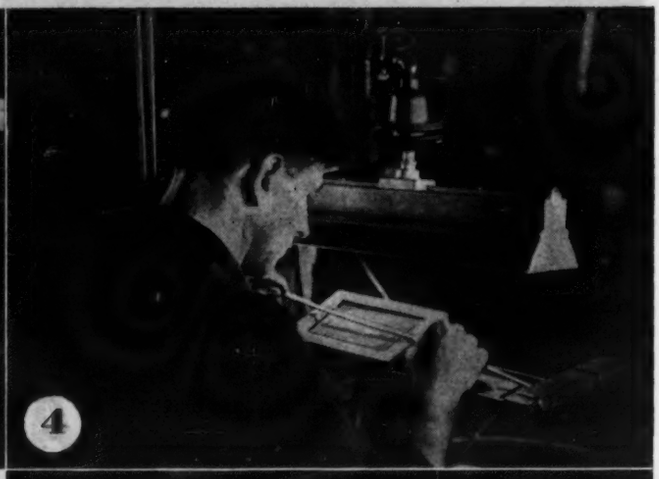
A leading wire manufacturer put in better lighting, found *production up 25%.* An electrical equipment maker installed G-E Infra-red Lamps, thus reduced drying time from *hours to minutes.* In shell manufacturing, G-E Mazda Lamps have cut inspection time — reduced eye-strain and fatigue and increased plant output.

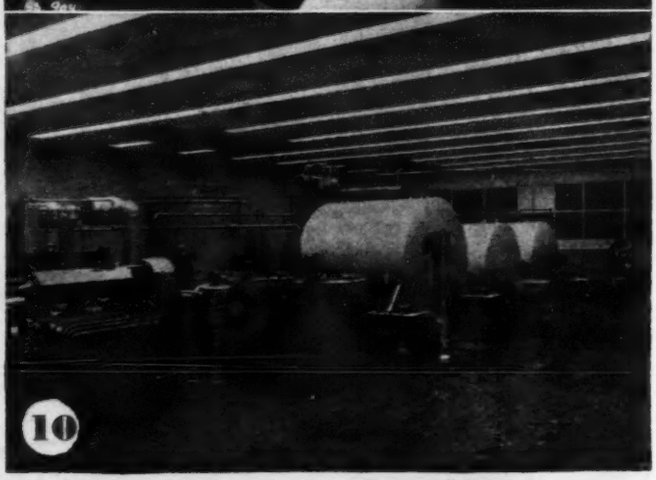
Such results are not exceptional with engineered lighting—*plus* G-E Lamps. In the ten successful installations shown here, G-E Mazda Lamps provide high-efficiency, low-brightness illumination at low cost. Why not consider what better lighting—with G-E Lamps—can do in *your* plant?











1. Fewer mistakes in this *drafting room* because G-E Fluorescent lighting reduces shadows to a minimum.
2. *Safety hazards* are sharply reduced when G-E Mazda Lamps provide high-level illumination for safer seeing.
3. Extremely fine *detail work* moves faster, better, more accurately with abundant light furnished by G-E Lamps.
4. This *inspection* operation uses low brightness, high footcandle lighting to spot defects in steel ribbon.
5. High footcandles for close *assembly* work save rejects and reduce spoilage. G-E Mazda Lamps help do it.
6. Adequate *office lighting* with G-E Fluorescent Lamps provides better working conditions, raises morale.
7. Versatile G-E Infra-red Lamps save time—speed production in this oven *drying* installation.
8. Soft, diffused fluorescent light from G-E Lamps enables *supervisors* to maintain high standards of efficiency.
9. High *precision* depends on accurate readings. Abundant, glare-free lighting with G-E Mazda Fluorescent Lamps will make instrument reading easier.
10. With high levels of cool fluorescent light from G-E Lamps, this plant maintains *quality*, promotes cleanliness.

CONSULT your G-E Lamp supplier. More than 60 years of technical skill and engineering knowledge are available to solve your problems. Better call him today.

"TO MAKE G-E LAMPS STAY BRIGHTER LONGER"

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G-E MAZDA LAMPS

BUY MORE WAR BONDS

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Hear the G-E radio programs: "The G-E All-Girl Orchestra," Sunday 10:00 p. m. EWT, NBC; "The World Today" news, Monday through Friday 6:45 p. m. EWT, CBS; "The G-E Houseparty," Monday through Friday 4:00 p. m. EWT, CBS.

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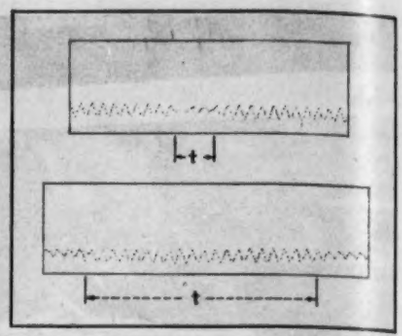

FIG. 3—Tape trace of waves for timing. Upper trace is for time interval measured with damped 60-cycle wave, lower for undamped wave

opposite positions from those shown.

This graphic method has advantages over the electronic methods since the tape will record the bouncing of the contacts and will indicate the correctness of contact adjustment. Also a permanent record exists on the tape. This graphic timing method does not require calibration since the timing interval is a function of the supply frequency.

The accompanying tapes (Fig. 3) show how quickly and accurately the interval may be measured. Where the supply frequency is held constant a ruled graph will aid in the quick counting of the cycles during the time interval.

Once the switches A, B, and C are properly set, the double blade switch XY is closed. This energizes the driving motor as well as the 60-cycle coil. Next the "S" switch is closed. This energizes the HGA auxiliary relay which starts the timing of the interval, as well as the energizing of the relay under test. When the contacts of the relay under test close the time interval is complete, and the "XY" switch may be opened to de-energize the driving motor.

•

Using Linen Tapes Near Live Wires

The easiest way to prevent accidents in connection with the use of measuring tapes in the vicinity of live conductors, says the Liberty Mutual Insurance Co., Boston, is to employ only linen tapes for this purpose. In a recent bulletin the company urges marking the cases of all metallic or metal-reinforced tapes to prevent their use under such conditions. Five accidents are analyzed which involved metal-reinforced tapes. In one case an employee lowered such a tape from

the arm of a steel tower to measure clearance between a 110-kv. line on towers and a 66-kv. line on poles. The tower leg was 11 ft. from the outside wire of the 66-kv. line below the employee. Free end of tape was blown against this wire, burning down the conductor and injuring the employee. The tape burned off where it came in contact with the tower. Rendered insensible by the shock, the man was saved from falling about 40 ft. to the ground by the belt on his overcoat which caught on a tower leg.

In a second instance a survey party laying out a new line encountered an existing 13.8-kv. line across the route. To obtain data for the new line a metal-reinforced tape was foolishly thrown over the 13.8-kv. circuit, the idea being to halve the tape reading for the actual clearance measurement. When the tape dropped on the line the conductor was burned down and the tape disappeared, fortunately without injury to the field man.

Other Clearance Measurements

A man on a wooden ladder placed against a pole structure was holding the case of a metal-reinforced tape. In lowering the tape to measure clearance it was blown into adjacent primaries, flashed and disappeared.

Two men were working on bus reconstruction with the bus alive. To find the length of some tapes, the ring on the end of a metal-reinforced tape was placed on the pin of a switch stick. The stick was then raised vertically until it became even with the bus conductor, the second man holding the tape taut to measure the distance from the bus to the terminal where the connection would be made. The end of the tape on the switch stick contacted the bus while one man was holding the tape and was in contact with the case of a grounded piece of equipment. Result, a fatality.

In the last case reviewed a crew was completing a tie between a line tower and a steel switching structure. The ties were run and the tapes were being made up for installation when the 11-kv. line was de-energized at noon. Two men were on the tower to measure by eye and tape the length of the conductor with the case on the ground. When one of the linemen grasped the end of the tape below the conductor a flash occurred, temporarily blinding the two men on the tower. No other injury was sustained and the line was not burned down.

REACHING FIRE FIRST

Randolph "4" Carbon Dioxide Fire Extinguisher

OUT OF THE BRACKET, INTO THE FLAMES . . . ALL WITH JUST ONE HAND. HERE'S SPLIT-SECOND FIRE FIGHTING—THE EASY WAY!

Few people think about fighting fire until they actually face the flames. That's why it's so important that every fire extinguisher on your property operates *easily—quickly—thoroughly.*

Randolph "4" speeds your fire defense. Chokes off gasoline, oil, paint, machine, electric fires—instantly. Hits the blaze before damage is done!

Approved by Underwriters' Laboratories, Inc.

Mobilize against fire with Randolph carbon dioxide. For complete details and prompt service, call your supply house or write us—today.

JUST A TOUCH OF THE THUMB...

sends powerful carbon dioxide into the blaze . . . snuffs out generator, switch, motor, dynamo fires in split-seconds. Has no valves or nozzles to adjust.

Randolph "4" does not damage equipment or conduct electricity. A safe, dry gas, it leaves no trace, stain or mess. Will not deteriorate or freeze in extreme temperatures—eliminates annual recharging.

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Send for **FREE** booklet "Sharpshooting at Flames." Illustrates CO_2 fire-fighting.

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Industrial

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NEMA Places Range Textbooks in Schools

By DON BENSON
National Electrical Manufacturers Association
New York, N. Y.

Some 10,000 teachers of home economics in high schools and colleges have asked for and have now received copies of a 68-page textbook on electric cooking and the design and operation of the electric range. Accompanying the textbook is a large wall chart on the front and back of which the details of electric range features are shown. The book and chart were prepared for and are being distributed by the Electric Range Section of NEMA. Text and its arrangement in the book are the work of a well known authority in home economics, Miss Eleanor Howe, of Harvey & Howe, Inc.

The book and chart have been and are being advertised in full-page space in home economics journals, including *What's New in Home Economics*, *Practical Home Economics* and *Journal of the American Association of Home Economics*. As stated, these advertisements have already resulted in 10,000 requests for copies.

Content of the book is conveniently arranged for teaching. Each of the eleven chapters is divided into two parts, one for information of the teacher and which is the basis of instruction, the other part a brief review and short quiz which is especially designed for easy reproduction by mimeograph or other process for copies to be given to pupils.

The eleven lessons include an introduction on the art of better cooking and sections on how electricity supplies heat; how the range is designed; how top unit and well cooking, roasting, baking and broiling are done; how special convenience features are used; how to clean a range; how to select one; how to plan the kitchen. In the last section notice is given to the need for adequate wiring, and arrangements of equipment for different shapes of kitchens are presented. Included, also, is a special discussion on design of school laboratory kitchens.

The book and chart are now available to electric utility sales executives and home economists and through them to any teachers who may not already have obtained copies on their own application.

•

Silver Bowls in RLMs Solve the Problem

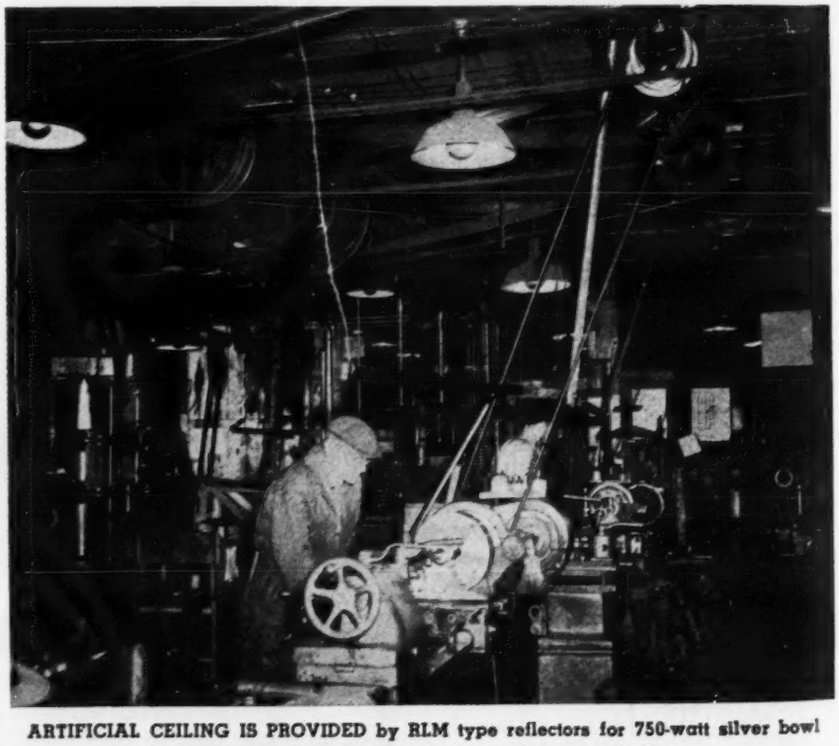
Silver bowl lamps in RLM reflectors solved a lighting problem for Multnomah Iron Works in Portland, Ore., in a machine shop with ceiling so cluttered with pulleys, belts and line shafting that there was no room to install fluorescent lighting even if desired. Reflectors are spaced irregularly about 8 ft. apart and mounted 9 ft. from the floor. RLM reflectors of the 750-1,500-watt size serve as "ceiling" areas for 750-watt silver bowl lamps. The installation provides 65 ft.-candles of well diffused indirect lighting and has proved highly satisfactory for the exacting machine work done in the shop.

D. O. Bergy, utilization engineer for Northwestern Electric Co., laid out the job.

•

Purifier System Kills Fish Odors

Producing fish meal and fish oil, the processing equipment of Consolidated Fisheries, Lewes, Del., was responsible for unpleasant odors in the vicinity of the plant which threatened its existence as a going concern until a special Sturtevant exhaust system was designed and installed to get rid of the odors by washing the process air. Products of combustion from dryers are now carried through a fan into a dust collector, where solid matter settles to the bottom, the noxious air being discharged into a spraying chamber where the odors are



ARTIFICIAL CEILING IS PROVIDED by RLM type reflectors for 750-watt silver bowl lamps to furnish 65 foot-candles of well diffused machine shop lighting

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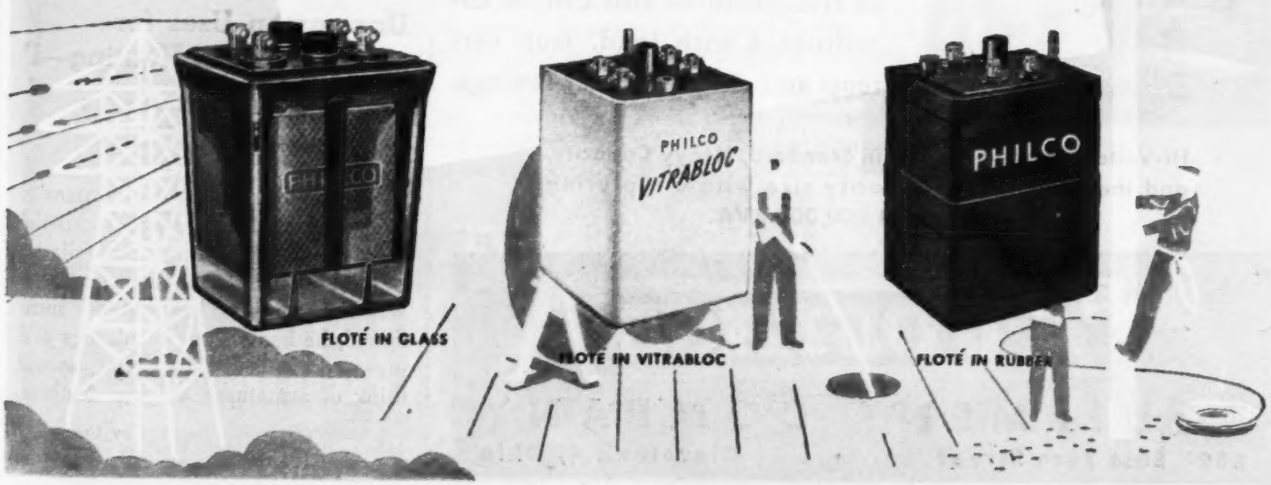
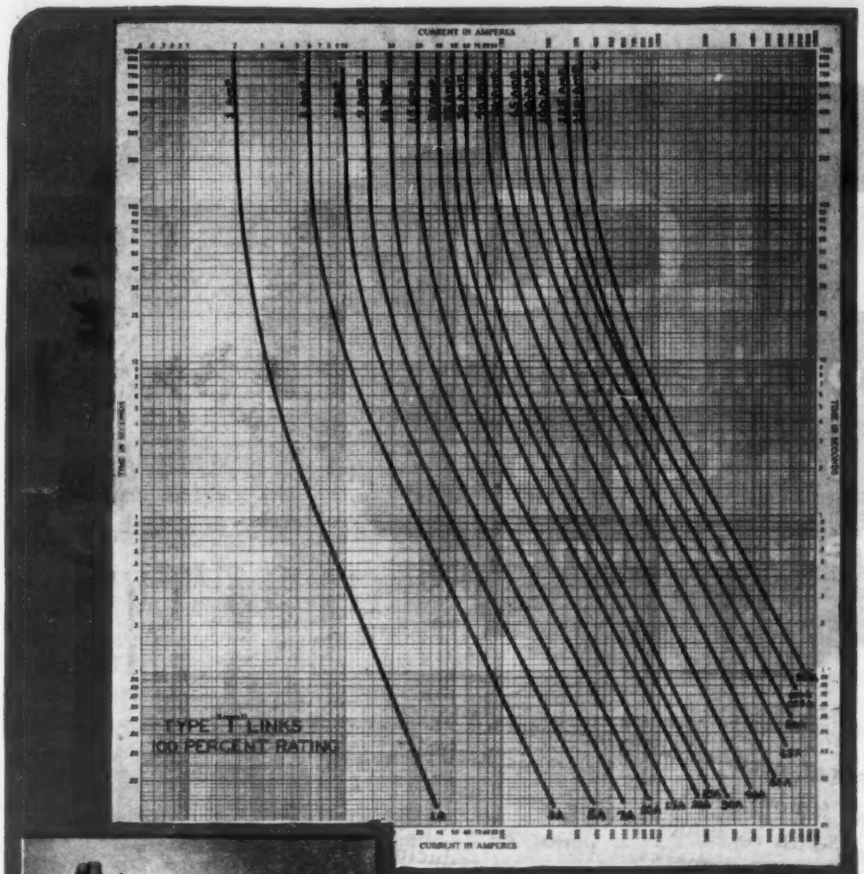
FOR THE SPECIAL needs of utility engineers, Philco provides the famous Floté element. This basically different battery, with its longer-lasting grid cast in a new high-efficiency metal marks a major advance by eliminating low cells in full float service, by reducing maintenance and charging costs, and by materially increasing battery life. Providing high capacity, compactness, toughness and long trouble-free service, Philco Floté Batteries are available in modern steel glass, rubber and Vitrabloc jars—in capacities and sizes for all control and auxiliary power requirements. Write for latest catalogs. PHILCO CORPORATION, Storage Battery Division, Trenton 7, New Jersey. *Makers of the Famous Philco "Thirty".*

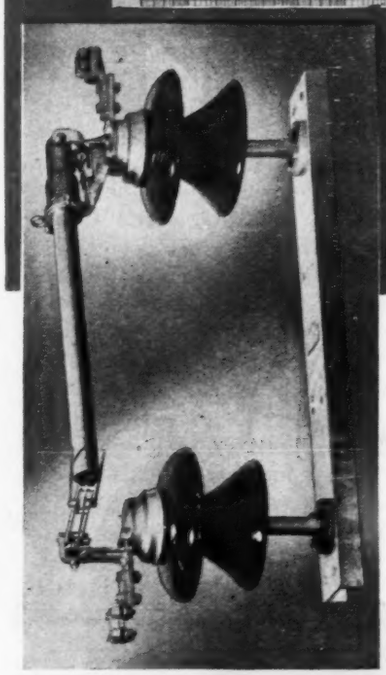
For 50 years a leader in Industrial Storage Battery Development



FLOTÉ IN GLASS FLOTÉ IN VITRABLOC FLOTÉ IN RUBBER



4000 Faults cleared last year by HI-VOLTAGE FUSES at a cost of new fuse links only

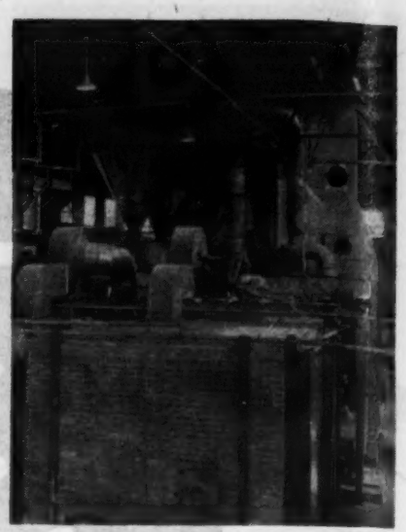


• The Time-Current Characteristics provide protection for equipment and also service on the line.

They are timed for the high side of transformers and can be coordinated with load, fault currents and circuit breaker settings.

Hi-Voltage Fuses are built in Standard, Heavy Capacity, and the Extra Heavy Capacity size with a rupturing capacity of 1,000,000 KVA.

HI-VOLTAGE
EQUIPMENT COMPANY
2891 East 79th Street • Cleveland 4, Ohio



MOTOR-DRIVEN FANS remove fumes from fisheries plant and eliminate neighborhood annoyance

washed out and the spray water piped far out to sea.

Two No. 55 Sturtevant planing mill exhaust fans, each driven by a 15-hp., three-phase, 220-volt, Westinghouse general purpose motor running at 1,800 r.p.m. were installed. These fans have a wheel diameter of 37.5 in. and are especially adapted for pneumatic conveying work. Each fan exhausts 20,000 c.f.m. of air or gas and is designed to handle air at 300 deg. F. Two centrifugal collectors form part of the installation. Long-hour operation is a feature.

The installation is located in an outlying area and created no problem until a unit of the U. S. Army was stationed nearby and entered an injunction plea against the company. With the smell removed from the surrounding air, the court dismissed the injunction.

•

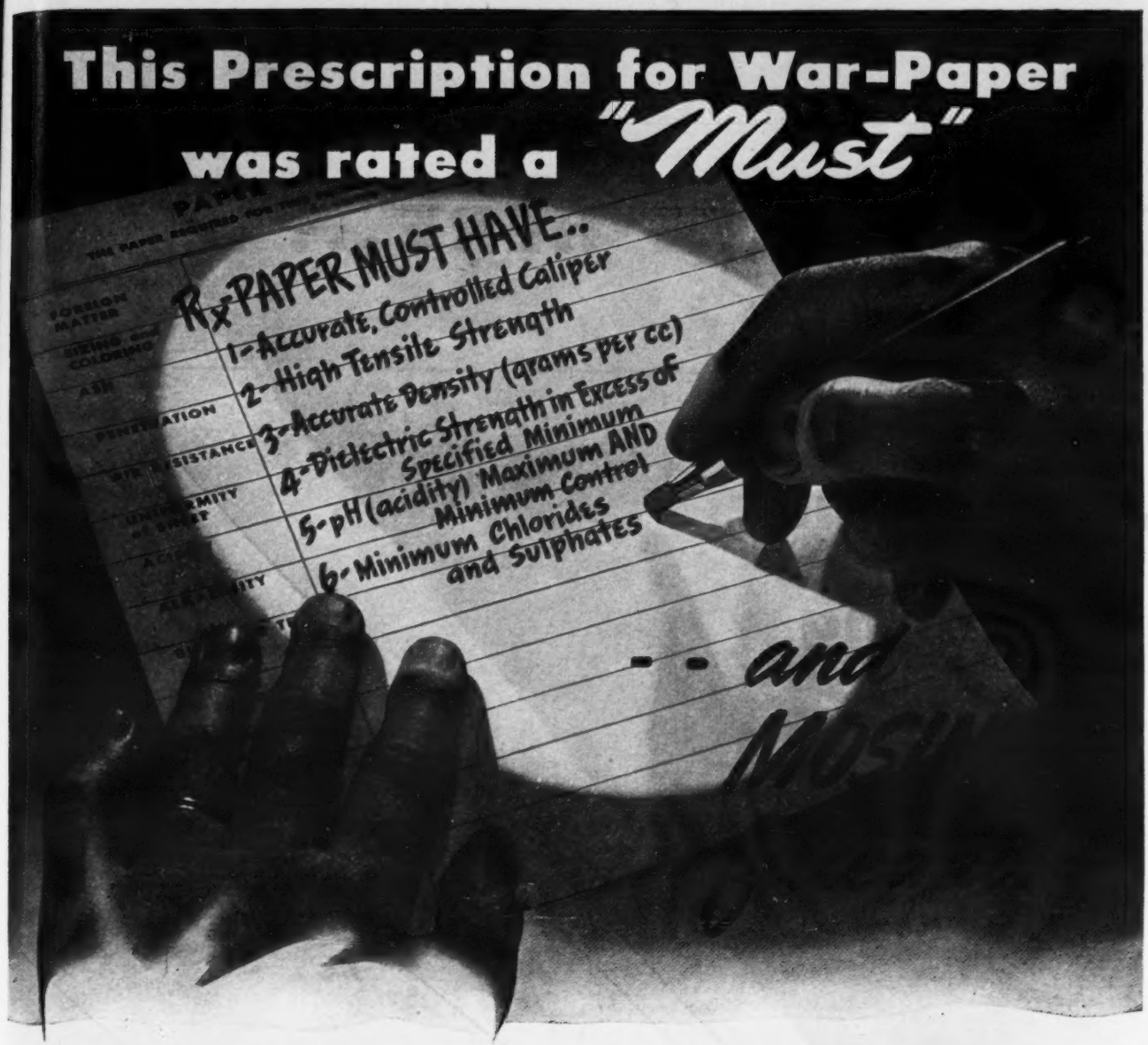
Uncommon Uses for H. F. Heating—I*

By E. D. TILLSON
Testing Engineer
Commonwealth Edison Co.
Chicago, Illinois

When induction heating comes to the mind of the average industrial plant manager he thinks immediately of the heat treating of steels or alloys. When dielectric heating is mentioned, he has visions of plastics and plywood. It isn't likely that he will think of armatures, chicken feathers,

* Based on paper presented by the author before "High Frequency Heating Conference" sponsored by Great Lakes Power Club and Chicago Lighting Institute.

This Prescription for War-Paper was rated a "Must"


Rx PAPER MUST HAVE..
1-Accurate, Controlled Caliper
2-High Tensile Strength
3-Accurate Density (grams per cc)
4-Dielectric Strength in Excess of Specified Minimum
5-pH (acidity) Maximum AND Minimum Control
6-Minimum Chlorides and Sulphates
- - and

Paper becomes the deciding factor of success or failure in many products. For instance: A product made according to a prescription *approximating* the above, had stood up for years in normal prewar service. But when certain new war weapons made additional demands on this product, it failed.

The paper part of the product proved to be the cause of the failure. Proper adjustment in processing the paper, re-writing of the prescription and establishment of proper controls to attain the maximum limit of one of the ingredients (formerly ignored), prevented further failures. MOSINEE thus made another valuable contribution to the war effort.

Engineering MOSINEE to work better in your processing or packaging equipment and re-writing of your paper prescription may be the answer to success for your product. Consultation between your technicians and Mosinee engineers can be arranged without obligation, at your convenience.

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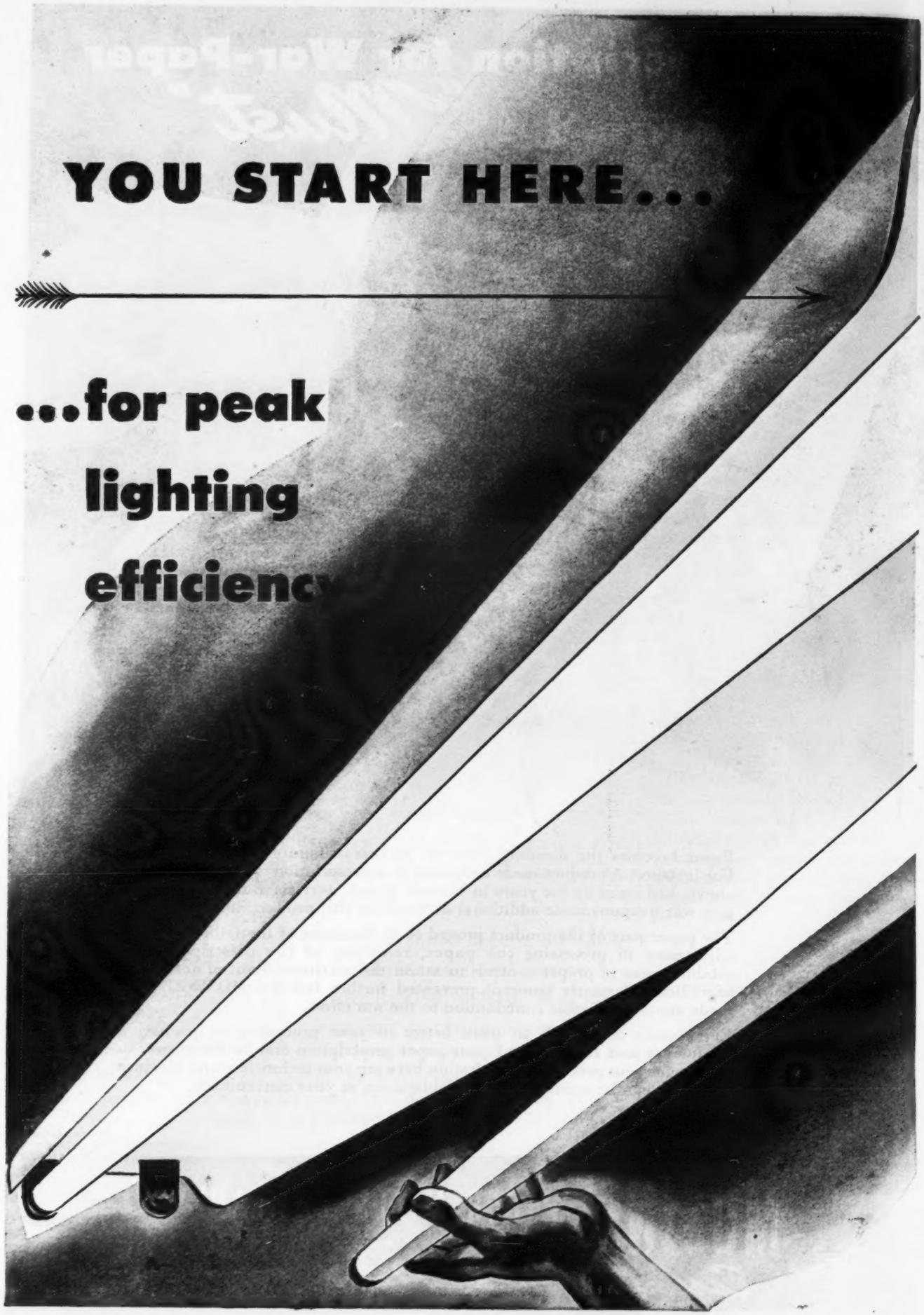
MOSINEE • WISCONSIN
Essential Paper Makers


YOU START HERE...
...for peak
lighting
efficienc

The best lighting system is no better than its lamps —and no lamps are better than Westinghouse.

Their efficiency is outstanding because

- research never stops
- raw materials are the best obtainable
- manufacturing technique has been refined to the highest degree
- testing and seasoning assure top dependability.

These are the reasons why Westinghouse Lamps are prime business builders. Just as they bring out the best in any lighting system so they will produce sales—real prestige business—the kind that lasts. Westinghouse Electric & Manufacturing Co., Bloomfield, N. J.

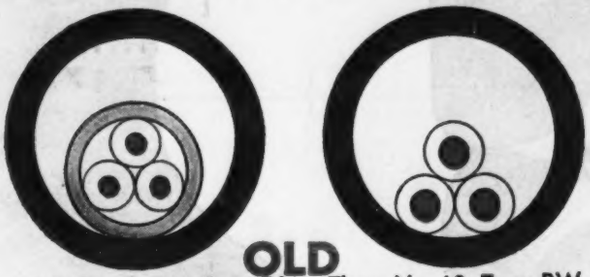
Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

MAZDA LAMPS FOR SEE-ABILITY

• RUBBER POWER CABLES • VARNISHED CAMBRIC CABLES •

CRESCENT SYNTHOL
TYPE SNW
FOR MORE COPPER IN WET LOCATIONS



OLD
No. 14/3 Conductor, Type RL Carries 15 amps.
Three No. 10, Type RW Carry 25 amps.

For ¾" Conduit

NEW
Three No. 6, Type SNW Carry 54 amps.

Insulated with a special thermoplastic that is extremely resistant to moisture, acids, alkalies and oil, inherently flame-retarding, high dielectric and mechanical strength, bright, permanent colors, small diameter, easy pulling free stripping

SYNTHOL TYPE SNW

is approved by Underwriters Laboratories in sizes from No. 14 through No. 4/0 AWG under section 3035 of the 1940 N.E. code for use in raceway systems, such as: (a) Underground, (b) In concrete slabs or other masonry in direct contact with the earth, (c) In wet locations, (d) Where the condensation and accumulation of moisture within the raceway is likely to occur.

Write for Descriptive Folder on SYNTHOL Types SNW and SN

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

Available Through Electrical Wholesalers

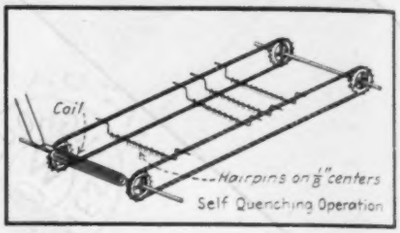
• IMPERIAL NEOPRENE JACKETED PORTABLE CABLES •

• ARMORED CABLE • CRESFLEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE CABLE • BUILDING WIRE •

• PERMACORD • LEAD-ENCASED AND PARKWAY CABLES • SYNTHOL WIRES • WELDING CABLES • SHIPBOARD CABLES •

popcorn, surgeons' sutures, golf clubs or hog medicine. Yet these are only seven out of 200 heterogeneous processed or semi-processed materials that have been brought into the Commonwealth Edison Co. testing laboratory during the last 13 months for induction and dielectric heating experiments.

Here, then, is another service that the electric utility can render to its industrial customers many of whom have come to look upon the utility as an authority on electrical matters and have confidence in its judgment. Accepting this concept of customer service Commonwealth Edison Co. announced to its industrial customers, more than a year ago, that induction and dielectric heating units had been obtained, through the courtesy of equipment manufacturers, for making heat trials and invited industrial plant managers to bring in products for test.



CASE 1—Induction heating tempers hairpins in ½ sec. Coil is 18 in. long

The results were surprising. While not all of the experiments resulted in the sale of heating equipment, however, the number of machines added to the company's lines by customers engaged in war production augurs well for the future. Many other interested customers with low priority ratings or none at all must wait. Still others plan to use heating equipment in postwar production, the problems being studied or require further experimental work to complete solutions. Suffice it to say that before the war is over many Chicago industrial firms will know about induction and dielectric heating at first hand and in a way that they are not likely to forget after the war.

To illustrate the diversity of application of high frequency induction and dielectric heating, 14 cases in which high frequency heating has been applied successfully at our laboratories have been selected; 7 induction heating applications and 7 dielectric heating applications.

Two of these are illustrated herewith. Of the remainder, two applica-

Learn How War Production Industries Are *CONSERVING MANPOWER* With Benjamin Lighting Equipment

In these four ways Benjamin Lighting Equipment is helping American Industry to meet the manpower problems involved in war production.

1. **IT IS REDUCING ACCIDENTS.**
2. **IT IS CONSERVING ENERGY,** thus reducing fatigue.
3. **IT IS HELPING OLDER EMPLOYEES** to STAY ON THE JOB.
4. **IT IS REDUCING LABOR TURNOVER** because the plain fact is that people prefer to work in well-lighted plants. They like to work under good light . . . and they do better work, not just because they can see better but also because they feel better and more cheerful, the work seems to go along easier.

This Free Guide will Help You Make Sure Your Lighting is Right.

The free booklet, "Benjamin Specifications for Productive Lighting in War Plants" contains complete data on how to approach, analyze and solve lighting problems. Send for it now . . . there is no cost or obligation. Benjamin Electric Manufacturing Co., Dept. **K,** Des Plaines, Ill.

Benjamin Illumineering Insures Proper Lighting of Seeing Tasks

When you call for a call by a Benjamin trained lighting specialist, you secure engineering assistance that insures best possible lighting from viewpoint of Sufficient Light, Quality of Light, Light Distribution, Light Diffusion, Light Control and Shielding.

BENJAMIN TRADE MARK
Lighting Equipment
Distributed Exclusively Through Electrical Wholesalers

• RUBBER POWER CABLES • VARNISHED CAMBRIC CABLES • PERMACORD • LEAD-ENCASED AND PARKWAY CABLES • SYNTHOL WIRES • WELDING CABLES • SHIPBOARD CABLES • IMPERIAL NEOPRENE JACKETED PORTABLE CABLES • ARMORED CABLE • CRESFLEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE CABLE • BUILDING WIRE

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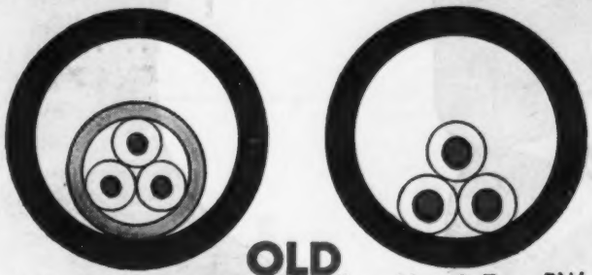

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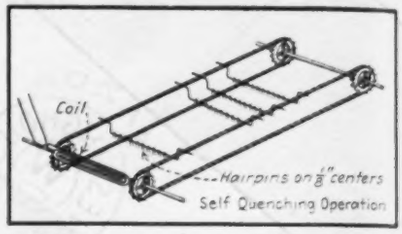

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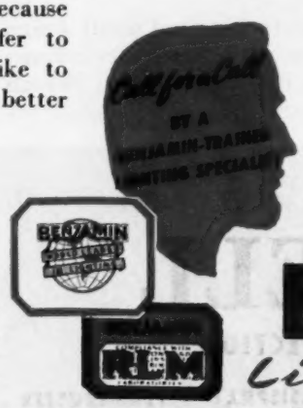

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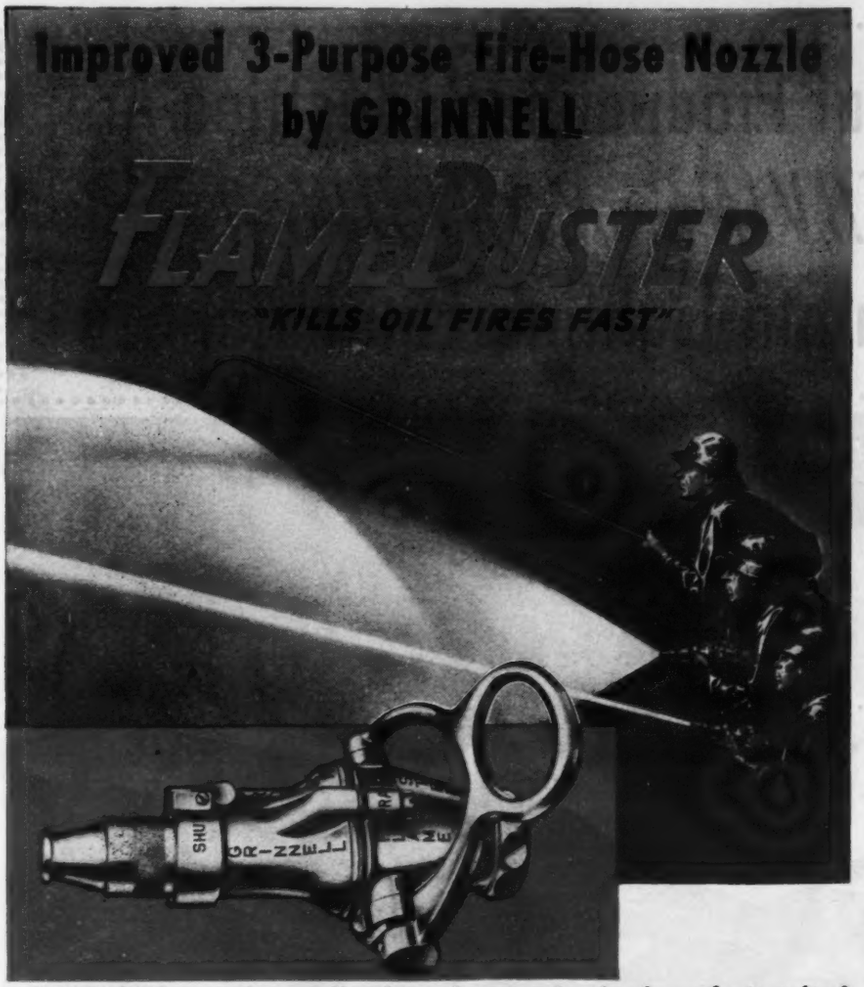


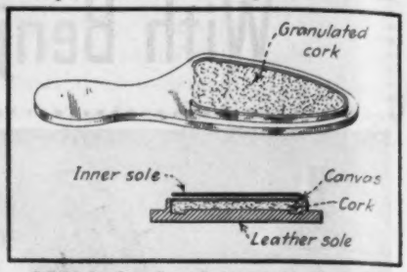
FLAMEBUSTER permits application of water in the form best suited for quick control, according to the nature of the fire —

1. **Low Velocity Spray** . . . for extinguishing stubborn fires in light, flammable liquids. Projected at a wide angle by the unique Grinnell spray tip on a 4′ or 10′ applicator. The spreading cone of evenly distributed, fine spray, applied directly over blaze, puts out flames quickly, with minimum water consumption.
2. **High Velocity Spray** . . . for general fire fighting and for extinguishing fires in heavier oils by emulsifying the blazing oil with a driving spray of water, rendering it incapable of burning. Protects fireman approaching blaze.
3. **Solid Stream** . . . for rooting out deep seated fires and for projecting a volume of water a considerable distance. For fighting fires in electrical apparatus, a long-range, non-conducting spray is substituted for the solid stream.

FLAMEBUSTER'S single large orifice in high velocity tips and scroll design in low velocity tip prevent clogging. Easy disassembly simplifies maintenance. Grinnell Company, Inc., Executive Offices, Providence 1, R. I. Branch offices in principal cities.

tions, one dielectric and one induction heating, will be described in each of six succeeding issues of ELECTRICAL WORLD.

Case 1. Consider the common hairpin that comes 100 pieces to the pound. The plant producing them makes 7,000 lb. per 8-hr. day. The hairpins must be tempered and the test for this is to spread the prongs 1¼ in. They must spring back flat. Traditional tempering method is with convection ovens. The hairpins are racked ⅛ in. apart on the conveyor shown and tempered by high frequency induction heating in ½ second. The coil recommended is 18 in. long and the required temperature 550 deg. F.



CASE 2—Bond cork insert in shoe sole with dielectric high frequency heat in 2½ min. Cloth is bonded to inner sole

Case 2. Two operations in the boot and shoe business appear to be "naturals" for dielectric heating. One, shown, is the forming of a granulated cork insert in the sole using Uformite No. 552 urea resin bond and requiring only 2½ min. for operation. The other is the bonding of canvas cloth to the inner sole with the same resin. Still other uses have been tried, but their feasibility is yet to be established.

•

$2 Minimum Bill for Farm Customers

It is expected that a large market for domestic appliances and farm electrical equipment will open up in the territory of the Virginia Electric & Power Co. as the result of the rate provisions of a new rural development plan recently announced. Rural customers will be served on the regular city and town rates that apply in the areas, the only exception being that revenue from line extensions shall average not less than $6 per mile. On a basis of three customers per mile, this means that in most cases minimum bills will be only $2 per month.

Cathode Ray Tubes For War and Post-War

AMONG the many types of tubes produced by North American Philips for war purposes is the 5-inch cathode ray tube illustrated here. The problem with this type tube was to produce it in volume with evenly coated screens having no pinholes or other defects.

The ability to produce, in volume, NORELCO cathode ray tubes that meet rigid specifications, is the result of experience gained by an organization with a background of over half a century of research and development in the electrical field.

Although NORELCO tubes now go to our armed forces, a list of tube types we are especially equipped to produce will be sent on request.

North American Philips will have post-war facilities available for the development and production of tubes for projection television; also amplifier, transmitting, rectifier and special purpose tubes.

Write today for interesting booklet on "How and Why Cathode Ray Tubes Work" and the brochure describing the background of North American Philips in the science of electronics.

• *When in New York, be sure to visit our Industrial Electronics Showroom.*

Norelco Electronic Products by

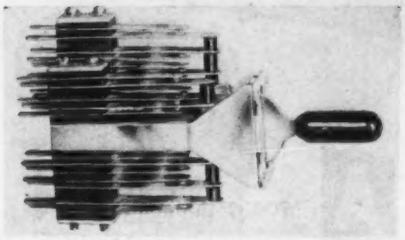
OTHER PRODUCTS: Quartz Oscillator Plates; Searchray (Industrial X-ray) Apparatus, X-ray Diffraction Apparatus; Medical X-ray Equipment, Tubes and Accessories; Tungsten and Molybdenum Products; Fine Wire; Diamond Dies.

NORTH AMERICAN PHILIPS COMPANY, INC.

Dept. G-4, 100 East 42nd Street, New York 17, N.Y.
Factories in Dobbs Ferry, N.Y.; Mount Vernon, N.Y. (Metalix Div.); Lewiston, Me. (Elmet Div.)

NEW EQUIPMENT

Lever Switch



Series "4200" lever switch. **Donald P. Mossman, Inc.**, 612 N. Michigan Ave., Chicago 11, Ill.

Lever switch which is reported as light in weight and compact in size and because of flexibility of circuit arrangements and combinations of contact form is reported as usable in communication circuits, testing apparatus and radio equipment.

•

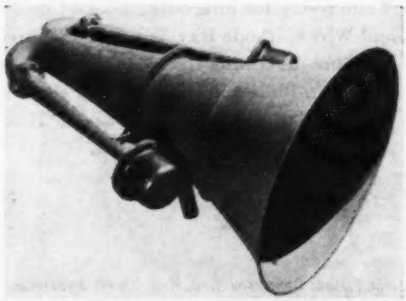
Control Timer

Timer; synchronous motor operated; silver contacts; 2 circuit control. **Reynolds Electric Co.**, 26 W. Congress St., Chicago 12, Ill.

Timer designed to control manufacturing operations in which starting is initiated by momentary contact pushbutton, stopping automatically at pre-set time. May be equipped with interlocking controls so that each operation must be completed in correct sequence before the next is started. Failure at any point is said to post a signal and timer to recycle automatically to starting position.- Control is syncronous motor operated and may be arranged to control additional circuits.

•

Loudspeaker



Model "24-A" loudspeaker; bell diam. 25 in.; over-all length 38 in.; frequency response 110 to 6500 c.p.s. **Langevin Co., Inc.**, 37 W. 65th St., New York 23, N. Y.

Loudspeaker which is designed primarily for outdoor applications has a vitreous finish which is said to retain it non-corrosive qualities. Horn is of exponential form and has frequency response of from 110 to 6500 c.p.s. Receivers are available for coupling two or four driver units and making horn capable of maximum inputs of 50 and 100 watts.

•

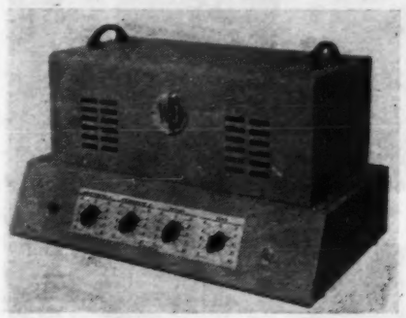
Battery Plug

Type G8-3-21CFS battery plug; 600 amp. capacity. **Cannon Electric Development Co.**, 3209 Humbolt St., Los Angeles 31, Calif.

Plug, which is 7 in. long and 2 1/16 in. wide at the engaging end, is said to be of streamline design and to use spring clips on its phenolic shell. This construction is said to allow cleaning and replacing contacts without altering cable connections. Contacts are leaded copper with phosphor bronze spring and terminals are adaptable to soldering or crimping. Unit has a built-in push-botton switch.

•

Amplifier

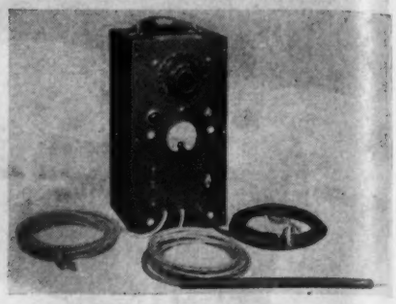


Portable 30-watt amplifier; 3 input channels; tone control; speaker selector; fuse protected; carrying handles. **Walker-Jimieson, Inc.**, 311 S. Western Ave., Chicago 12, Ill.

Unit operates on 110 volt, 60 cycle and is said to be humless and distortionless. It has two mike inputs and one phono input. Output impedances of 4, 6, 8, and 500 ohms may be selected. Frequency response is reported as 50-10,000 cycles, record gain as 69 db. and mike gain as 116 db. Tubes employed are 3-6SJ7, 2-616, 6N7 and an 83. Amplifier is housed in a 17 by 10½ by 19½ in. gray wrinkled finished steel cabinet.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Insulation Tester



Portable insulation tester; input 115 volt, 60 cycle test voltage output from 0 to 2500 volts; capacity 750 volt-amperes; wt. 47 lb. **General Electric Co.**, Schenectady 5, N. Y.

Complete set, which is built into a 15 by 9¾ by 8¾ in. case, consists of a dry-type, step-up transformer, variable autotransformer for voltage control, indicating voltmeter, air circuit breaker with instantaneous overload trip, and control switches. Two 15-ft. shielded test cables, one with an insulated test handle and the other with a spring clip for grounding one side of the high-voltage circuit, and a 15-ft. supply cord with a connecting plug and ground clip are provided. Set safety features reported are case grounding through third conductor in supply cable, signal lamp which remains lighted when set is energized, and shielded and grounded high-voltage test leads.

•

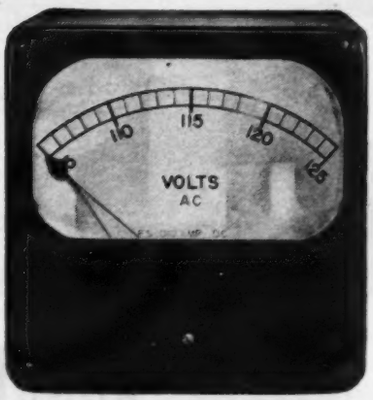
Towers

"Blizzard King" radio or structural tower; 90 to 425 ft. **Harco Steel Construction Co., Inc.**, 1180 East Broad St., Elizabeth 4, N. J.

Towers, whose individual members weigh an average of 5.3 lb. are fabricated to facilitate erection. It is reported that a 4-man crew is sufficient for all tower erection and erection time runs from 10 hr. for 90-ft. design to 50 hr. for the 425-ft. tower. It is reported that bolt and sleeve construction allows use of unskilled labor.

•

Voltmeter



Magni-scale voltmeter; accuracy 0.2 of a volt. **Control Corp.**, 600 Stinson Blvd., Minneapolis 13, Minn.

Equipment consists of a standard voltmeter instrument and a small steel box containing the auxiliary electronic devices. The a.c. potential to be measured is fed through an input transformer to an electronic rectifier. This potential is opposed

WHY?

ARE HUBBARD NO. 4-11-44 WIREHOLDERS SO STRONG

When a dead-end load is applied to a Hubbard 4-11-44 Wireholder, the first thing that happens is a close conformation to the porcelain of the Copperweld wire bail, which runs around the wire hole. This distributes a compression load over the largest possible area of the porcelain. *The metal bail carries the load,* the porcelain merely rides the bail like a saddle.

This is evident on observing the construction of the Hubbard 4-11-44. But not so well understood, is how the bail-fastening to the base stands up so well. At first glance it would seem that increased loading would simply straighten out the hooked ends of the bail and cause them to let go. By referring to the diagram it will be seen why this is not so.

As the load is increased at "A" beyond normal strain, the base starts to "bow" up slightly at "D". Immediately the shoulders at "B" and "C" are drawn in against the bail "E", gripping it over a fairly large area, like the jaws of a vise. The harder the pull, the tighter the grip until the ultimate of the bail wire is reached.

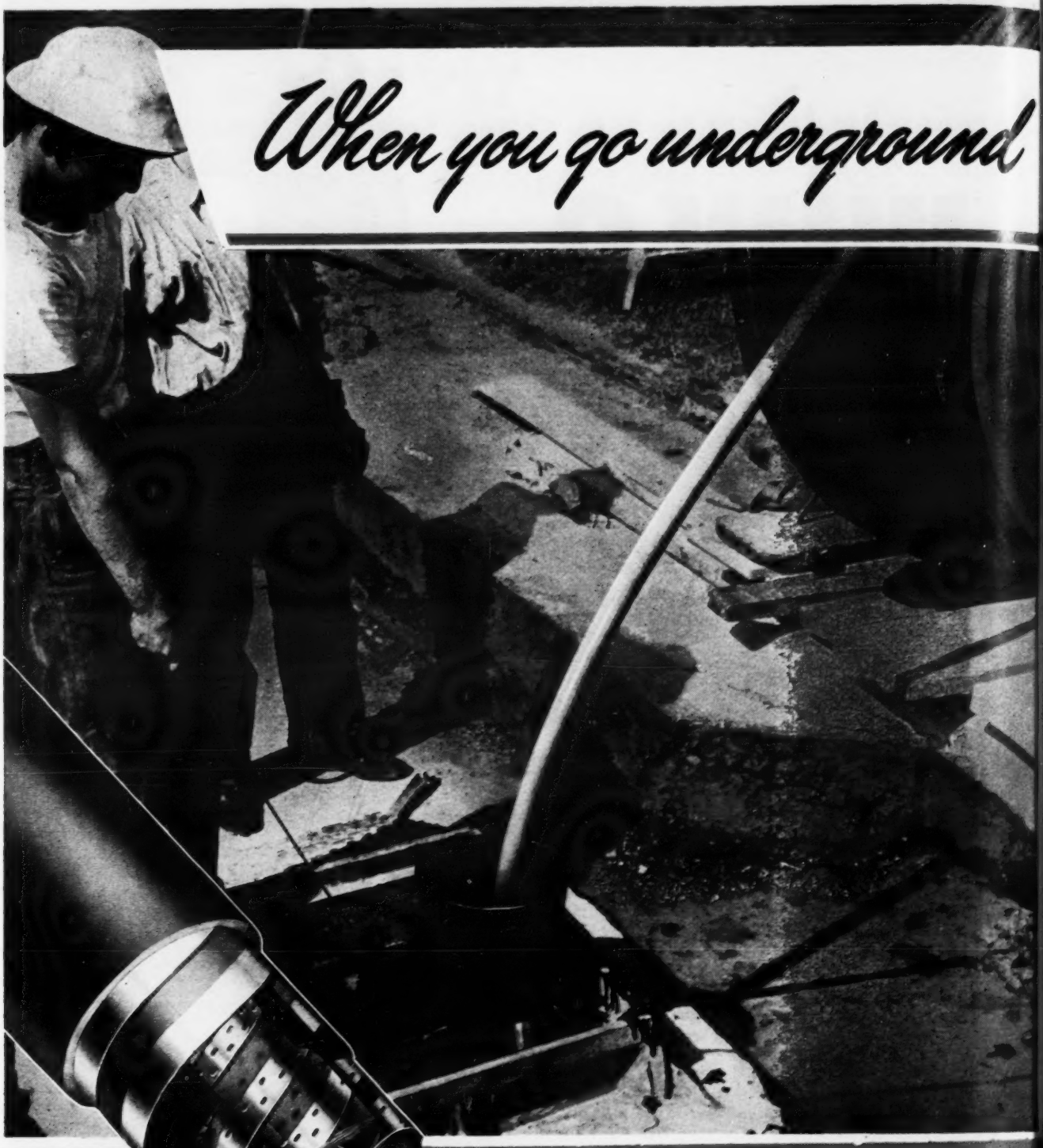
*Tests have shown that before the bail breaks the normal mounting would long since have pulled loose. Attached to a solid beam of hard wood one Hubbard 4-11-44 Wireholder will support the weight of a light automobile.

**The full strength of any wireholder will not be developed by a poor mounting. Thin siding, soft splintery wood or loose bricks will give way under a very low strain. Avoid weak mounting.*

HUBBARD AND COMPANY

PITTSBURGH . . . OAKLAND, CALIFORNIA . . . CHICAGO

When you go underground



Weatherproof Wire · Rubber Covered Wires and Cables
Service Entrance Cables, including Thin-Wall Insulated
Building Wires and Cables · Rubber Sheathed Portable
Cables · Rubber Insulated Power Cables · Telephone
Wires · Varnished Cambric Power Cables · Magnet Wire
Bare Copper Strand · Pigtail and Braided Copper
Trolley Contact Wire

PACEMAKER IN WIRE PRODUCTS

ROE

ELECTRICAL W

...go ROEBLING

A Quality-Controlled Cable that gives long low-cost service!

PERHAPS YOU, like many other utility engineers, are blueprinting your plans right now...for removing unsightly poles and going underground in a number of business and residential areas.

Whether you plan to use a standard cable or develop your own specifications, Roebling can serve you. Every phase of the manufacturing process, from hot-rolling copper bars to final testing is performed in the Roebling mills, where quality is controlled and trouble-free, long-life service assured.

A representative from our nearest office will be happy to discuss your immediate problems and future plans.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

Cable emerging from a lead press at the Roebling plant in Trenton, New Jersey

BLING

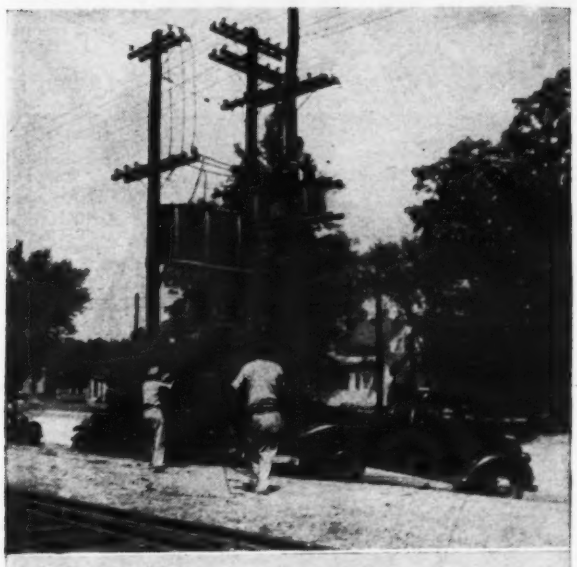
JR ROEBLING

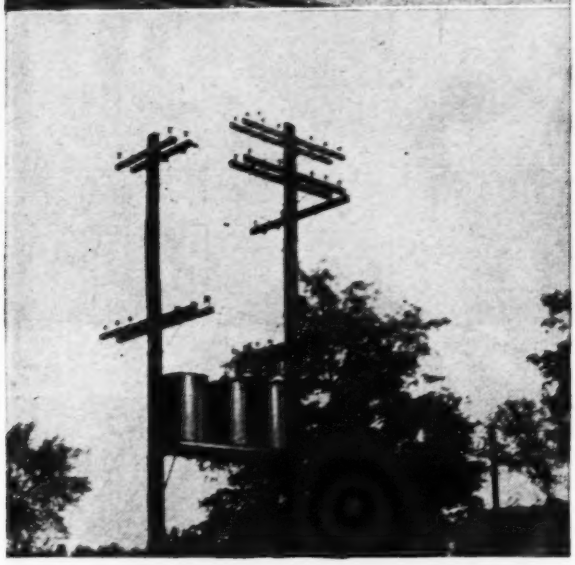
WIRES AND CABLES

NO. 4 OF A SERIES ON THE *Service Superiority* OF

DAVIS TRANSFORMERS

Standing Overloads





These DAVIS transformers are on the lines of a utility servicing a war plant. Due to rapid expansion of the war plant, the 3 DAVIS 15 KVA transformers became overloaded. For several months they were carrying a load much closer to the 150 KVA which should have been provided than the 45 KVA available. In this overloaded condition, they withstood line surges caused by summer thunderstorms with no lightning arrestors on the line.

The oil in the transformers became so hot that, even in cold weather, it literally boiled over and ran down the sides of the cases. Yet the 15 KVA units did not break down. They were in good operating condition, when finally replaced, after 10 months service, by the 50 KVA transformers

The upper picture shows a bank of three 15 KVA transformers being removed after the installation of three 50 KVA units. The lower picture shows the three 50's in operation.

Had the 15's failed, the war plant would have had to shut down, while replacements were installed. This example of the dependability of DAVIS transformers, proves their reliability even under extreme circumstances.

●

DAVIS TRANSFORMER COMPANY

DAVIS TRANSFORMER CO.
Phone 177 CONCORD, N. H.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION NEMA MEMBER

and

STOCKWELL TRANSFORMER CORP.
CONCORD, N. H.—Phone 177 AKRON, OHIO—Phone Jefferson 4179

Manufacturers of Oil Cooled, Dry Type, Power and Distribution Transformers
Also All Types of Specialty Transformers Regardless of Size

by a constant d.c. potential from the electronic voltage stabilizer. The difference between the input potential and the stabilized potential is supplied to the voltmeter. There are two calibration adjustments—one governing the level of the constant bucking potential which determines the low point of the scale and the other adjustment, a resistor in the voltmeter circuit, determines the upper scale limit. The voltage band which is of primary interest to the operator covers a full scale range. Uniform scale is reported as easy to read and instrument sensitive to small variations.

●

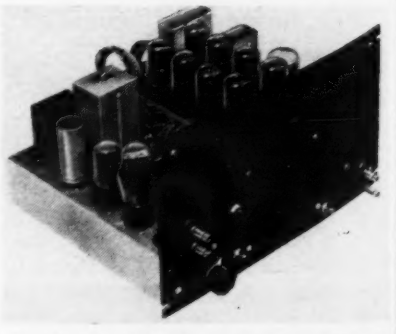
Frequency Meter

Model "4009" reed type frequency meter: 380 to 420 c.p.s. **Wirshing Mfg. Co.**, 3234 Mines Ave., Los Angeles 23, Calif.

Reed type frequency meter which operates within the range of 380 to 420 c.p.s. operates on voltage range of 100 to 150 volts. Specials have been built for operation on voltages as low as 20. Units are enclosed in 3½-in. black metal or Bakelite cases and said to comply with Air Corps specifications and A.S.A. (C 39.2-1944) mounting dimensions.

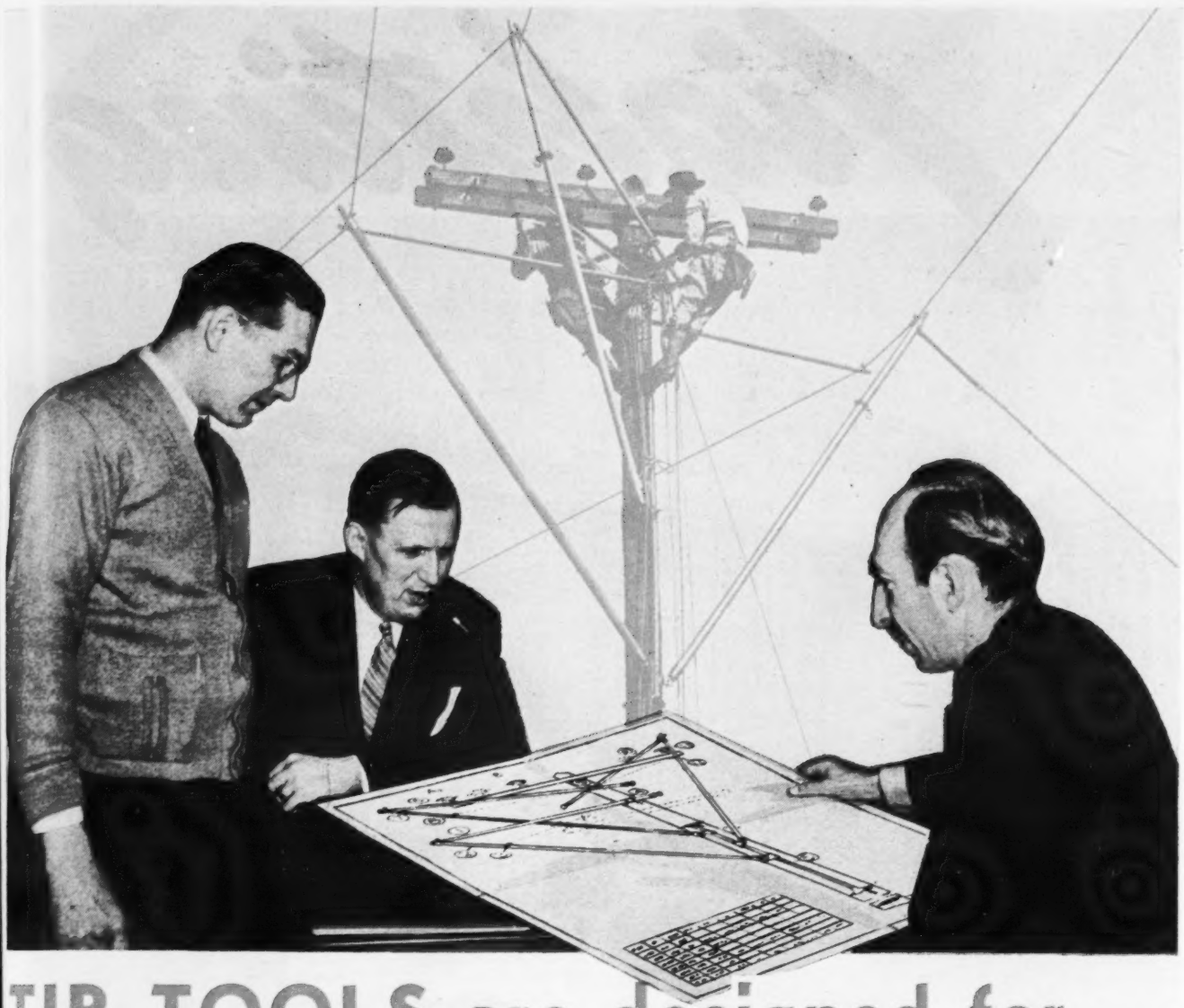
●

Electronic Counter



Two-decade electrode counter: up to 1,000 cycles per second. **Potter Instrument Co.**, 136-56 Roosevelt Ave., Flushing, N. Y.

Electronic counter which is designed for industrial and laboratory use is actuated by a closing contact, sine wave, or pulse input (as from a photo-cell) at rates up to 1,000 cycles per second. Each decade divides by 10 resulting in a scaling factor of 100. Count for 0 to 99 appears on two banks of neon lamps. A telephone-type relay is connected to the counter output and the contacts of this relay close once for each 100 input cycles. These contacts are connected to an output terminal. A conventional electro-mechanical counter may be connected to the output terminals to extend the count to as many places as desired.



TIP TOOLS are designed for . . . Simplicity of Operation-Safety-Service

Consult this Tips Tool Catalog of Electrical Live Line Equipment for detailed information on the selection of tools and the methods for doing a variety of hot line maintenance jobs. It has sixteen pages of "how to do it" information on twenty-four different repair jobs.

If you do not have a copy of one of our Master Catalogs—where the same information is available—send for yours today.

A. B. Chance Company Engineers and Field Demonstrators are hard to please when it comes to the designing of Tips Hot Line Tools. They demand the ultimate in simplicity of operation, safety and serviceability.

This method for working on three phase lines is an example of the results they obtain. It is one of the safest, most efficient means yet devised for moving and holding live conductors at a safe distance while defective cross arms, broken insulators or damaged poles are replaced. In fact, this method has defied improvement for several years.

By combining the practical experiences of our field men and the skill of our design and testing engineers with the many suggestions received from our customers in the field, Tips Tools have been developed to handle practically every kind of line repair work without interrupting service. The result is that most maintenance jobs can be done "hot" with Tips Tools quicker and easier than they can be done "cold". There is no loss of revenue, no disgruntled customers, no time wasted in obtaining clearances, grounding, etc., and the men who do the work are actually safer than they would be working on a supposedly "cold" line, risking the possibilities of unexpected current surges.

For safety to linemen, economy of operation, and customer good will, equip line crews with hot line tools that bear the Tips Tool trade mark of dependability.

"THERE'S NOTHING TOO GOOD WHERE LIFE IS AT STAKE"

TIPS TOOLS

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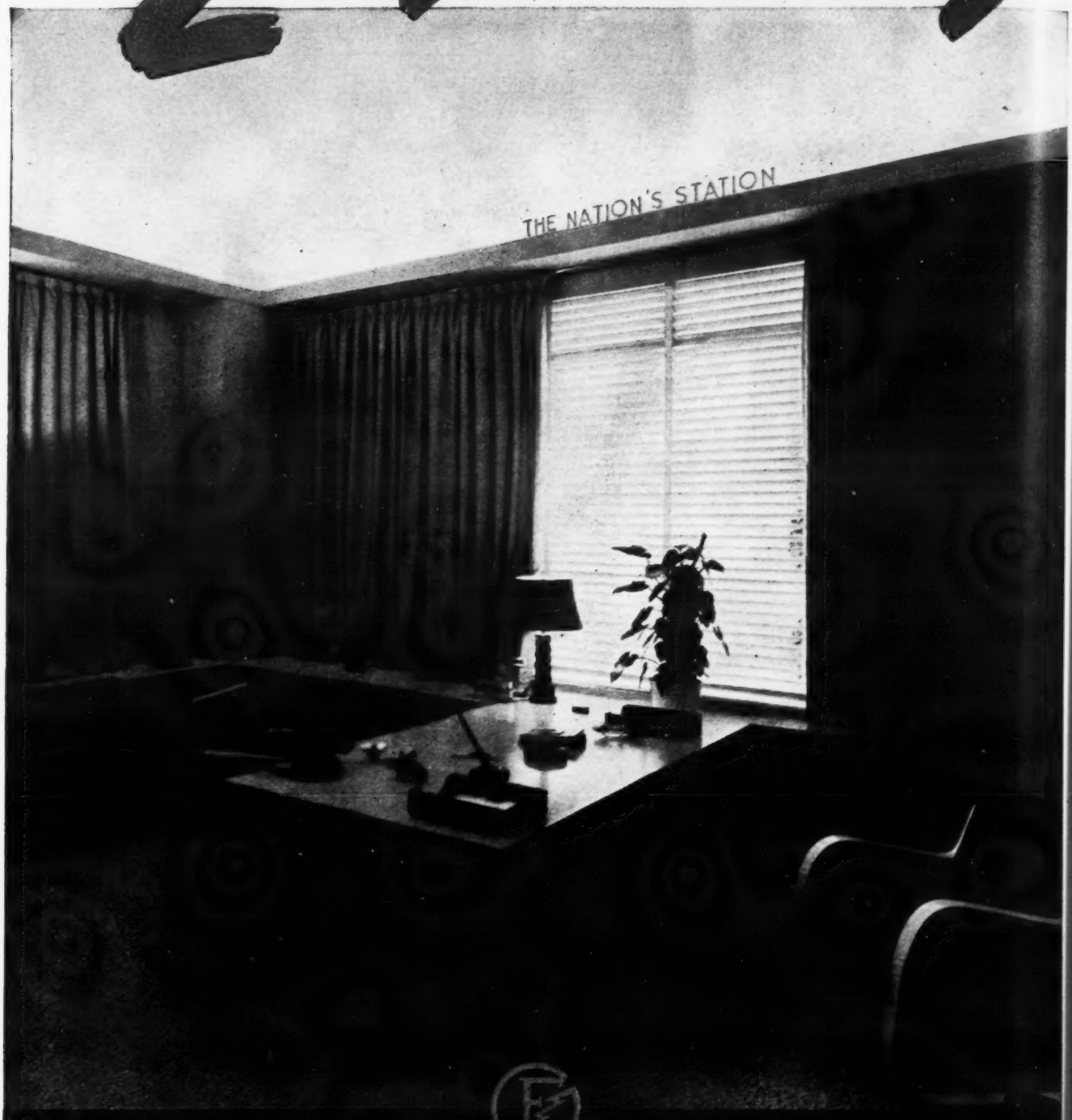
CENTRALIA, MISSOURI.

ABC INDUSTRIES

lighting



LIGHTING DIVISION

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-with COLD CATHODE Fluorescent Lighting

Many years of pioneering have given Federal Electric lighting engineers the "know how" when it comes to modern, effective and efficient lighting systems for all purposes—industrial, hotel, building, office, store, display, and decorative lighting. For some years Federal Electric Company, Inc., has been a recognized leader in the manufacture of Cold Cathode fluorescent lighting equipment. With Zeon Cold Cathode fluorescent lighting, illuminating engineers and electrical contractors have successfully solved many highly involved lighting problems. Let men like these help you get the most efficient lighting at a minimum cost.

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ZEON

COLD CATHODE

FLUORESCENT LIGHTING

The mark of lighting quality

Remember: *There are two kinds of fluorescent lighting!*

"Hot Cathode" is the common heater filament type of fluorescent lamp; "Cold Cathode" is the improved shell-electrode type, of which Zeon is the outstanding example. Long life, lower maintenance cost, greater flexibility are some advantages of Zeon Cold Cathode Fluorescent Lighting.

Take Advantage *of Lighting Information Service*

You, your architect, engineer, or contractor, are invited to submit your lighting problem in a detailed letter. Federal Electric Company engineers will give it thorough and immediate attention. Address Lighting Division, Federal Electric Company, Inc., 8700 South State Street, Chicago 19, Illinois.

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Military needs now take the entire output of Laytex Wires and Cables. But we hope the day is not far off when manufacture will be resumed for Residential and Commercial Building, Police and Fire Alarm Systems, Communications, Signalling, Power Control and other exacting services.

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TECHNICAL LITERATURE

Consultants—Association of Consulting Chemists and Chemical Engineers, Inc., 50 E. 41st St., New York 17, N. Y. has released the ninth edition (1945) classified directory which are available "for the asking." Section 1, Key sheet and index lists about 100 fields of chemistry and engineering; section 2, scope sheet of members; section 3, indexes and a guide for using the directory make up the 108-page booklet.

Electronic Heating—The ABC of Electronic Heating is a 16-page booklet written for both engineer and manufacturer. Facts are discussed without the use of confusing terminologies. It contains a brief record of historical background and development of electronic heating—explains principles of operation—describes the two chief methods and fields of application. Illustrations are used to amplify the text and several types of high frequency generators are shown. Booklet is available upon request from Scientific Electric, 107-119 Monroe St., Garfield, N. J.

Insulating Varnishes—A 56-page booklet containing tables, charts and text material on the subject of "Insulating Varnishes and Compounds" may be procured from John C. Dolph Co., Newark 5, N. J. It is a handy, ready reference for many problems, such as the selection of insulating varnishes and compounds, thinning of the varnishes, etc.

Bearings—Manual containing standard specification data on ball and roller bearings may be obtained from Ball & Roller Bearing Information Center, 16 E. 48th St., New York 17, N. Y. Data covers types of bearings, uniform basic part numbering system, standardized workmanship, inspection, tests, and a simplified form of tabulated dimensional data. Information was compiled by engineering committees of Anti-Friction Bearing Manufacturers Association and is endorsed by S.A.E. and A.S.A.

Ballasts—Sixteen-page booklet "Ballasts for Fluorescent Units" has sections containing information and illustrations on following subjects: importance of ballasts in fluorescent lighting, installation and operation, comparative mounting dimensions, wiring diagrams, future of fluorescent lighting, service suggestions, coefficients of light utilization, and recommended lighting levels. Booklet is obtainable from Hudson American Corp., 25 W. 43rd St., New York 18, N. Y.

Color and Light—Industrial booklet, "Color for Industry," presents advantages and disadvantages of color usage in industrial plants. Shows effect of white and various colored paints on ceiling and walls in so far as light and light effects are concerned. Copies may be obtained from U. S. Gutta Percha Paint Co., Electrical Dept., 14 Dudley St., Providence, R. I.

Antennas—Twenty-four page booklet on antennas and their usage in the war theatres is obtainable from Premax Products, Division of Chisholm-Ryder Co., Inc., Niagara Falls, N. Y. It is profusely illustrated with typical mobile and fixed installations and contains detailed line drawings on installations, mountings and circuits.

Standards — Publication No. 44-93, NEMA Distribution Cutout and Power Fuse Standards may be obtained from National Electric Manufacturers Association, 155 E. 44th St., New York 17, N. Y. for $1.00 per copy. It contains information concerning rating, performance, application and manufacture of distribution cutouts and power fuses.

Steel—Manganese Steel properties and typical usages is the theme of bulletin No. 44D which can be secured from American Manganese Steel Division, American Brake Shoe Co., Chicago Heights, Ill.

FROM WET TO DRY in 3 minutes!

Three minutes isn't very long. But it's long enough to dry a coat of olive drab paint on these wire reels vitally needed by the U. S. Army. Drying was formerly done by air, but this new INFRA-RED installation now accomplishes it better, more evenly —and in only 3 minutes!

INFRA-RED TUNNEL
mounted from ceiling in plant of the Bassick Company, Bridgeport, Conn. Photo courtesy Fostoria Pressed Steel Corp.

WABASH-BIRDSEYE INFRA-RED HEAT LAMPS

are standard for most infra-red tunnels, ovens, and other production line installations. In adapting your equipment to achieve the really dramatic results possible with Infra-Red remember that Infra-Red Heating is a science; and, for maximum efficiency Wabash-Birdseye Lamps should be used with scientifically engineered equipment. We will gladly furnish names of manufacturers of such equipment.

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NEWS ABOUT PEOPLE

Detroit Edison Promotes Collins; Miller Retires

Announcement has been made by the Detroit Edison Co. of the retirement, after 45 years' service, of William C. Miller, superintendent of electrical system. Harold W. Collins, formerly chief assistant to superintendent of electrical system, has been appointed superintendent. Delmar D. Chase, who has been a member of the company's system engineering staff for several years, has been appointed assistant to superintendent.

Mr. Collins started with the Detroit Edison Co. as a field tester of electrical equipment in 1919. He became relay engineer in 1926 and his duties later included responsibility for service continuity. In 1929 he was appointed assistant to the superintendent of electrical system in which position he was responsible for electrical testing and other phases of the technical operation of the system's network of lines and cables. As project engineer on the construction of several substations, Mr. Collins approved their design and coordinated the work of other departments concerned. Since 1919 he has worked under the direction of Mr. Miller. Mr. Collins is a member of the American Institute of Electrical Engineers.

Mr. Miller entered the employ of the Detroit Edison Co. as a lines and meter engineer. While with the company he held the positions of electrical engineer, assistant general superintendent, acting general superintendent in absence of superintendent, and in 1926 he became superintendent of electrical system. In this position he was responsible for the operation and maintenance of the electrical system. During his association with the Detroit utility, Mr. Miller was responsible for the development of improved circuit breakers, distribution transformer fuses and he played an important part in the design and lay-out of power houses and the 215 substations operated by the company. Mr. Miller is a fellow of the American Institute of Electrical Engineers.

W. C. Miller

H. W. Collins

Mr. Chase was employed by Detroit Edison in 1941 as an engineer in the planning division of the electrical system. In the same year he was loaned to the power branch of the WPB and returned to the company in 1942. In 1943 he was appointed bulk power engineer of the system engineering department. Previously, Mr. Chase was employed by the General Electric Co. in turbine generator design and in the central station engineering department. While with G. E., he received a Charles A. Coffin Foundation Award for work in the development of double-winding generators. Mr. Chase is a member of the American Institute of Electrical Engineers.

Maine Utility Elects Wyman Vice-President

William F. Wyman has been elected vice-president of the Central Maine Power Co., Augusta, retaining his previous title and duties as general superintendent.

Mr. Wyman joined the company in 1923 immediately after being graduated from Harvard College, and has had a wide experience in various phases of utility operation. This includes construction work on the Messalonskee hydroelectric station at Oakland, on wiring jobs, and at Boothbay Harbor as district superintendent, after which he supervised a number of line construction jobs, becoming division engineer in 1927 and rate engineer in 1928. In 1930 he was made manager of the central division and in 1930 was appointed assistant to the general manager, becoming general superintendent in 1942.

•

▶ JAMES V. CARVER, northern division engineer of the Jersey Central Power & Light Co., with headquarters at Morristown, has been transferred to Keyport as superintendent of the bay division. Mr. Carver entered the utility field with the Interstate Power Co. at Charleston, W. Va., in 1924. The following year he became identified with the Eastern New Jersey Power Co. at Asbury Park, serving successively as draftsman, chief draftsman, assistant distribution engineer and distribution engineer. In 1936 he went to Morristown as division engineer.

▶ C. E. PICKERING, industrialist of Ottawa, has been appointed as a member of the Ottawa Hydro-Electric Commission by the City Council of Ottawa. Mr. Pickering is president of Dustbane Products, Ltd., and of the Dustbane Manufacturing Co., Ltd., Ottawa and of the Dustbane Co., B. C., Ltd., Van-

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Though Ryerson steel-from-stock service to your company today can't always be as complete and fast as we'd like it, nevertheless, certain features of our service are probably more helpful than ever before.

If, for example, some particular item your company needs is not available—though our stocks in eleven plants are more diversified than any in the country—then we do our level best to recommend an item that will serve. And the recommendation is practical—made by men with extensive theoretical as well as practical technical experience with steel.

In most cases we can still deliver the steel you want, when you want it and where you want it.

Thus your purchasing executives can concentrate their steel-buying with Ryerson and know that Ryerson dependability is the same as always. That all your Ryerson contacts will be sincerely interested in helping with your steel problems. That all we have learned from more than 100 years in the steel business is at your service. If your company hasn't our latest Stock List and Data Book, will you please write our nearest plant.

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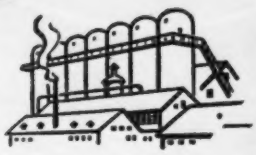
RYERSON STEEL

MECHANICAL GUARDIANS FOR ALL KINDS OF PIPE LINES



In chemical industries, synthetic rubber plants, oil refineries . . . any plant, piping precious or potentially hazardous fluids . . . a mistake, whether unintentional or deliberate, in adjusting a pipeline valve can prove both dangerous and costly. But prevention of these human errors is easy and infallible with BENDIX-CORY* SAFETY INTERLOCKS . . . the locks that say "No!" to unauthorized handling of your valves.

The BENDIX-CORY SAFETY INTERLOCK illustrated gives absolute control over the opening and closing of the valve to which it is attached . . . and, by use of an interlock key, can also control the position of this valve in relation to any number of other valves. The unit is wholly mechanical, and fully adjustable to compensate for valve wear—one of a number of interlocks specially designed for valve protection.

BENDIX-CORY SAFETY INTERLOCKS are dependable guardians for your pipelines. Write for full information.

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CHECK THESE FEATURES

- ✓ Interlocks stem valves 2" to 8". Other interlocks for globe, lead and porcelain valves.
- ✓ Absolute control of valve opening and closing under all conditions.
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- ✓ Ample strength characteristics.
- ✓ Indoor or outdoor installation without removing valve from service.
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- ✓ Position indicator (not shown) shows valve open or closed.
- ✓ Adjustable compensation for valve wear.

MARINE DIVISION
BENDIX AVIATION CORPORATION
106 Nostrand St., Brooklyn 5, N. Y.

INSTRUMENTS Bendix-Marine CONTROLS

couver, B. C. He has been prominent in civic affairs, having served as an alderman and controller of the City of Ottawa.

•

Pacific Gas & Electric Makes New Appointments

N. R. Sutherland, manager of the commercial department of the Pacific Gas & Electric Co., has been appointed San Francisco division manager of that utility effective April 1. James F. Pollard, who since 1943, has been associated with the office of the vice-president and executive engineer of P.G.&E., will succeed Mr. Sutherland.

N. R. Sutherland

Replacing Henry Bostwick, who is retiring from the company after 41 years of service, during 27 of which he held the position of San Francisco division manager. Mr. Sutherland has been associated with the P.G.&E. since 1913. He worked in various office departments and was advanced to the commercial department, of which he has been manager since 1923.

J. F. Pollard

Mr. Pollard was successively general

FOR PROTECTION

ALWAYS WHEN NEEDED
AND ONLY WHEN NEEDED

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THE CHASE-SHAWMUT COMPANY NEWBURYPORT, MASSACHUSETTS

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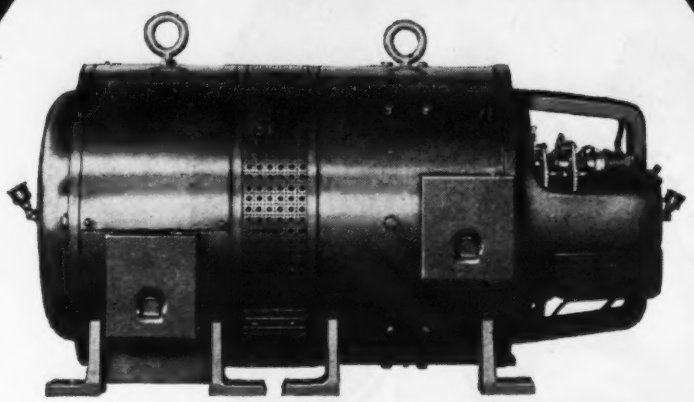
The E. P. DIVERTER POLE CHARGER



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Because:—

- Of the inherent characteristics it delivers satisfactory service at minimum operating and maintenance cost, prolonging battery life and conserving electrical energy.
- It is completely automatic in operation, eliminating all need of manual attention to the charging.
- It provides a closely controlled charging rate, enough to compensate for losses and maintain the battery in a healthy full charged condition.
- It protects itself against any damaging overload and shares all load up to safe capacity with the battery.
- It is thoroughly dependable. Specially designed, carefully constructed, adjusted to precision limits and thoroughly tested. It is built to safety first standards and has the endorsement of the battery manufacturers.
- There is not reversal of polarity or danger of "running-away". For complete details write for Bulletin No. 96.

The Electric Products Co.
1731 CLARKSTONE ROAD · CLEVELAND 12, OHIO

manager and president of the Seattle Gas Co. from 1930 to 1943, following many years in the employ of the P.G.&E. and predecessor companies. A graduate engineer of the University of California, he served as engineer on the staff of the California Railroad Commission from 1915 to 1918, and for several years he was general manager of Coast Counties Gas & Electric Co. at Salinas, Calif.

Other appointments announced are: T. W. Snell, manager of the Coast Valleys division at Salinas, will manage the San Jose division, succeeding I. B. Adams who retires after 46 years in utility company service. T. E. Ward, Richmond district manager, will succeed Mr. Snell at Salinas.

•

Rochester Utility Names Howe Vice-President

Ernest J. Howe of South Orange, N. J., for a number of years vice-president of NY PA NJ Utilities Co., with offices

in New York, has been appointed vice-president in charge of finance for the Rochester Gas & Electric Co.

•

▶ Benjamin J. Lindsay, formerly right-of-way agent for the Washington Water Power Co., has been appointed secretary of that utility, succeeding L. E. Morse, retired. Mr. Lindsay has been affiliated with the company since 1930. Mr. Morse entered the employ of the company in 1907 and had been secretary since 1929. R. B. McElroy, who entered the employ of the utility in 1913, will be manager of dealer sales development, which will be a separate activity under the "limited" company merchandise sales policy. Mr. McElroy has held various executive positions in the sales department since 1924. A. H. Wegner, as general commercial manager, will organize his staff to handle the general commercial functions with emphasis given to co-

when they offer thee a heifer, run with a halter

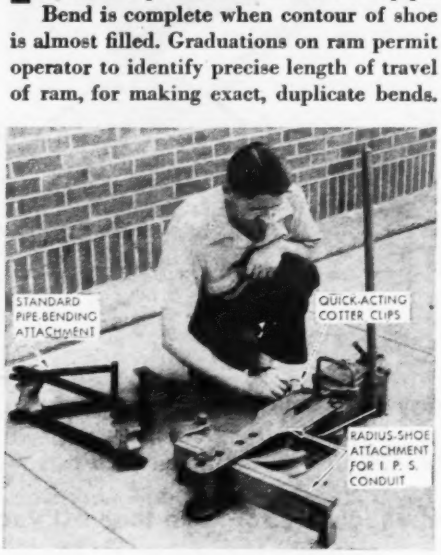
. . . . and, these days, if and when anyone offers you Macallen Mica, grab it quick. Because Macallen Mica has maintained highest standards of dependability for more than 50 years, it is natural that it should be so generally specified for the machines and instruments of war.

When you think of MICA think of MACALLEN

Speed Pipe Bending
THIS EASY GREENLEE WAY!

1 One stroke of quick-positioning lever brings shoe snug against pipe, ready for application of pressure. This short-cut eliminates time and labor of hand-pumping shoe into position. Then lever handle is transferred to operating lever.

2 By pumping operating lever handle, hydraulic pressure is exerted on pipe. Bend is complete when contour of shoe is almost filled. Graduations on ram permit operator to identify precise length of travel of ram, for making exact, duplicate bends.



3 Operating lever is forced down to its lowest position, releasing pressure. Handle is then transferred to the quick-positioning lever for withdrawal of ram. Pipe can be withdrawn entirely or moved for second bend. Then the process in steps 1, 2 and 3 is repeated.

4 Quick-acting cotter clips (an exclusive GREENLEE development) make change to another type of pipe-bending attachment a fast, easy job. With attachments, one bender can handle pipe, rigid and thin-wall conduit, bus bars and larger sizes of tubing.

Whatever the bending job . . . pipe up to 4½", rigid and thin-wall conduit, tubing, bus bars . . . there's a GREENLEE to do it better, faster! It's a portable tool, compact, easily carried to the job — packed in wooden carrying case.

FREE CATALOG 33E

Get complete facts on the complete line of GREENLEE Hydraulic and Hand Benders and other time-saving tools. Write today! Greenlee Tool Co., Division of Greenlee Bros. & Co., 1804 Columbia Avenue, Rockford, Illinois.

Get Ready with Greenlee!

REGISTERED TOOLS

GREENLEE

FOR THE CRAFTSMAN

ordinated planning and supervision of customer contact and promotional activities. He was Spokane division sales manager at the time of his promotion. CARL HOFFMAN has been promoted to the position of sales manager of the Spokane division to replace Mr. Wegner. He was formerly commercial sales supervisor in the Spokane division. E. E. SCOFIELD, as wholesale and special contracts manager, will contact and handle the contracts for wholesale, mining, and other large customers. He became affiliated with the Spokane utility in 1922. W. H. UDE, manager of the claim, tax and right-of-way department has retired. He joined the company in 1923 as superintendent of public relations.

•

New England Utilities Sales Officials Move

William Dee, sales manager of the Salem (Mass,) Electric Lighting Co., a New England Power System subsidiary, has been appointed sales manager of the Arlington Gas Light Co. He will be succeeded at Salem by Leroy S. Moore, sales manager of the Gloucester (Mass.) Electric Co. Elmer C. Stevens of the insurance department, northeastern district office of the N. E. Power system, will succeed Mr. Moore at Gloucester.

Albert Leddy, sales manager of the Haverhill (Mass.) Electric Co., has been appointed northeastern district merchandising manager, his territory including Haverhill, Amesbury, Lowell and Lawrence, Mass. William R. Leary, store manager of the Worcester County Electric Co., Worcester, Mass., becomes sales manager of Haverhill Electric.

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▶ J. S. WILSON has been promoted to the position of distribution superintendent of the Arkansas Power & Light Co. in Helena. Mr. Wilson has been a power plant operator for the past year. He was superintendent of the ice plant until Arkansas Power & Light Co. leased the electric property of Arkansas Utilities Co. early last year. Mr. Wilson has been in the utility business since 1918, most of this time having been spent in the engineering, transmission and distribution systems of companies in Texas and Missouri.

▶ H. H. COLEMAN has returned to his former position as manager of the Florida Power & Light Co. at Sanford, after two and a half years as a lieutenant in the U. S. Navy. CHARLES COLE, who served as manager during Mr. Coleman's absence, has been appointed manager of the company's plant

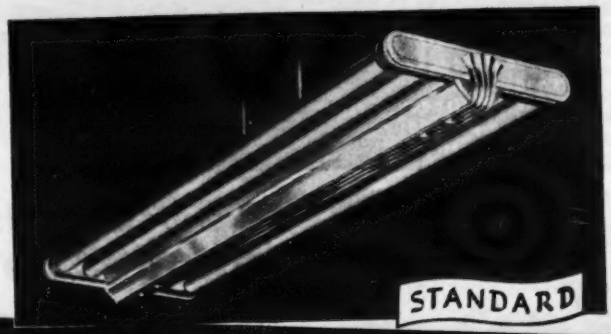
Talk about BEAUTY!

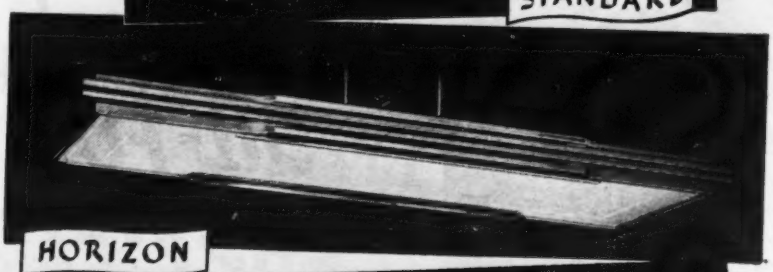
Take a look at these NEW SMITHCRAFT Commercial Units

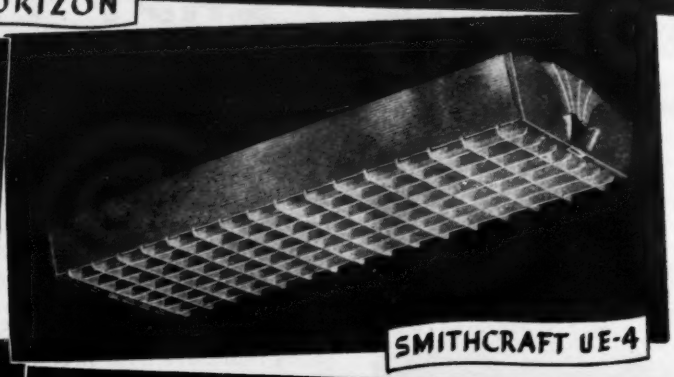
"Far ahead of anything in the field" is what the authorities say unhesitatingly after they have looked over this new line. These beautiful SMITHCRAFT Commercial Fixtures really are n-e-w . . . in conception, design and various maintenance angles. They are positively not "just another" embellishment of pre-war styles and thoughts. Finer architectural appearance . . . sturdy . . . and with exclusive definite features which insure maximum light output and lowest possible installation and maintenance costs.

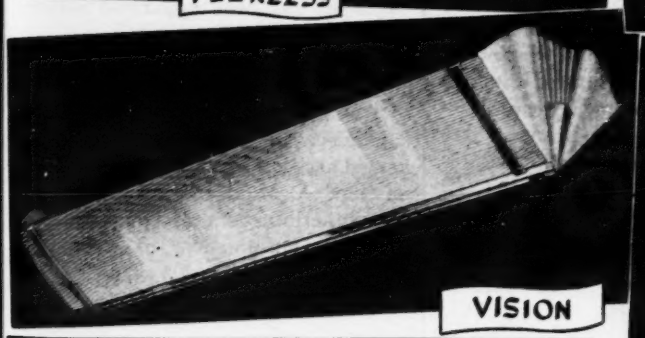
EASE OF INSTALLATION

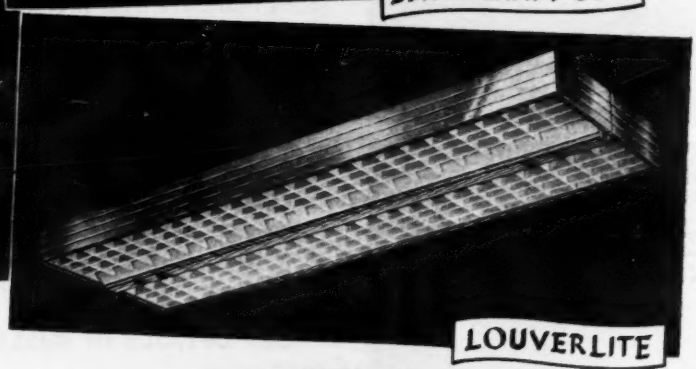
Completely equipped for either surface or pendant mounting, individually or in continuous rows, SMITHCRAFT FIXTURES have that balanced construction and maximum utilization of steel which make them light to handle and easy to install. Your attention is especially invited to the new exclusive Non-Turn Stem Lock which converts pendant mounting into a *one-man* job . . . and what a saving in time!

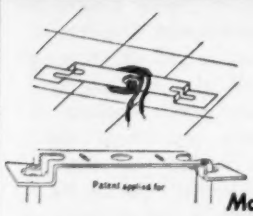












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Makes hanging a one-man job

Slips on • Locks tight

No threads • No bolts • No Tools

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LIGHTING DIVISION

Chelsea, Mass.

SWITCH BOX COVER made by EASY-FLO brazing stampings and parts, using induction heating with EASY-FLO preplaced at the 7 joints and all 7 brazed at one time. Finished cover equals one piece in all essential properties.

ROTOR BARS are joined to end rings by SIL-FOS brazing.

Better, Faster PRODUCTION OF Electrical EQUIPMENT—WITH SIL-FOS AND EASY-FLO

COPPER BUS BAR systems of all kinds are now constructed by SIL-FOS brazing.

SWITCH JAW assembly fabricated by EASY-FLO brazing.

BETTER production, because these two low-temperature silver brazing alloys, originated by Handy & Harman, provide joints with the special properties essential to electrical applications. On ***structural*** work, both SIL-FOS and EASY-FLO make joints that have high strength plus the ductility to stand severe stresses and strains. On ***electrical*** work, both alloys make joints that equal the usual current-carrying metals in conductivity and corrosion resistance.

FASTER production, because of the low working temperatures of SIL-FOS (1300° F) and EASY-FLO (1175° F) and their extreme fluidity—factors which also bring down metal joining costs.

GET DETAILS IN BULLETIN 12-A

You can't afford to overlook the product-improving, production-boosting, cost-cutting possibilities of SIL-FOS and EASY-FLO brazing, either in your present metal-joining or in your designs for the future. ***BULLETIN 12-A*** gives you the complete story. Write for a copy—now.

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in St. Augustine. Mr. Cole was formerly sales manager for the company in Miami.

•

California Edison Makes Additional Assignments

In addition to the appointments recently made by the Southern California Edison Co., the following assignments have been announced:

H. V. Busby, formerly assistant commercial manager, is now commercial manager. He joined the company in 1919 and has been active in its commercial organization.

L. F. Hunt, formerly senior electrical engineer, is now chief electrical engineer. J. D. Enefer, formerly engineer, is now assistant to the manager of the engineering department. C. T. Malloy, formerly superintendent of transmission and communication, is now general superintendent in charge of transmission, distribution and communication. C. M. Cavner, formerly superintendent of substations, is now assistant to the manager of operation. C. E. Heath, formerly system planning engineer, is now administrative assistant to the manager of operation. E. N. Husher, formerly assistant superintendent of distribution, is now superintendent of distribution. R. N. Coe, formerly superintendent of underground, is now assistant superintendent of distribution.

P. M. McCann, formerly superintendent of the Long Beach district, is now assistant superintendent of distribution. G. E. Moran, formerly assistant superintendent of substations, is now superintendent of substations.

H. L. Rudolph, formerly construction engineer, has been appointed assistant superintendent of substations. C. W. Sanders, formerly assistant superintendent of transmission, now superintendent of tranmission. D. Z. Bigler, formerly supervisor of transmission, has been named assistant superintendent of transmission. A. M. Burnett, formerly assistant superintendent of communication, is now superintendent of communication.

•

▶ W. W. Hurlbut, deputy general manager of the Los Angeles Department of Water and Power and chief engineer of the Water Works, retired April 1, closing a public service career of 37 years. Reaching retirement age last December, Mr. Hurlbut was retained for three months to assist General Manager Samuel B. Morris in completing a study of organization and personnel problems. A native of Wyoming, Mr. Hurlbut received his technical education at Colorado School of Mines, University of California at Berkeley and Stanford

RUST—a nuisance and a very costly menace in many plants no longer need be tolerated. Laboratory magic has furnished its master.

New Sinclair products, developed to solve tremendous military rust problems, are now available for your plant problem.

Sinclair RUST-O-LENE B for exposed metal surfaces of machinery in operation, in storage, or in transit

—provides a firmly-adhering rust proofing film
—prevents rusting of clean surfaces
—halts further rusting of corroded surfaces
—has lubricating qualities
—defies any degree of moisture from mere dampness to heavy rain
—can be readily removed when desired

Sinclair OPALINE RP (Rust Preventing) OILS for enclosed oil systems, prevent internal rusting of engines, hydraulic systems, gear reducers, and similar machinery intermittently operated, stored, or transported. OPALINE RP also has ample lubricating qualities for temporary use.

Both these remarkable Sinclair rust-preventives have successfully passed the most exacting service tests, and fully meet Government specifications.

Learn how RUST-O-LENE B and OPALINE RP can combat rust for you. Write for brochure giving full details.

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

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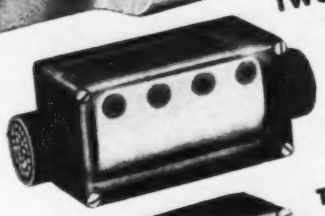
SAFE SURE O.Z. solderless connectors

O. Z. make a complete line of Solderless Connectors. They are safe, neat, compact, and permanent; they're sure connections because they give POSITIVE contact.

O. Z. Fittings are precision connectors of high quality, and give efficient long service. They are simple to install and easily accessible for maintenance.

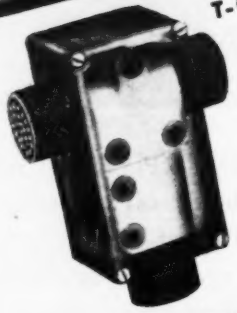
SOLDERLESS LUGS

A front connected lug for connecting wires or cables to flat bus bars or to other terminal points.



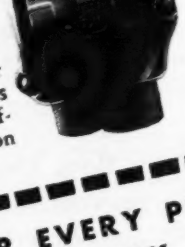
TWO-WAY CONNECTOR

For joining two cables of the same size end to end in a straight line. Canvas Bakelite cover insures positive insulation. Available with or without cover.



T-CABLE TAP

For taps at 90° angle to a main feeder. Canvas Bakelite cover offers efficient insulation—keeps connection dirt-free. Available with or without cover.



PARALLEL GUTTER TAP

Sturdy, compact, cast copper alloy body. Covers of Canvas Bakelite may be supplied for effective insulation and protection against grounds.

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Write today for the new 144-page O. Z. Catalog, which illustrates, describes and gives prices on wide variety of electrical fittings.

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REPRESENTATIVES IN PRINCIPAL CITIES

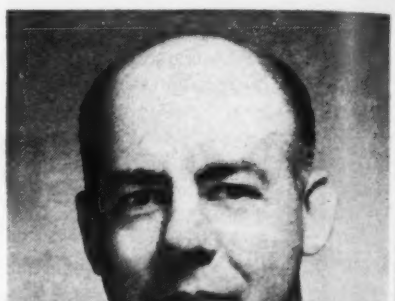
University. A chief assistant to former General Manager H. A. Van Norman, he was made deputy general manager and chief engineer of the water works in 1943.

•

Hotpoint Names Schafer Vice-President, Sales

Ward R. Schafer has been elected vice-president, Edison General Electric Appliance Co., in charge of sales. Mr. Schafer has been with Hotpoint since 1923, when he joined the company as an engineer in the commercial cooking division.

Subsequently he served as manager of product service, and was manager of



the company's range division when war production interrupted production in 1941. During 1942 he gained a leave of absence from the company to superintend the construction of a $26,000,000 butadiene plant in Texas. He returned to the company as manager of the western sales region in 1943, later being placed in charge of all Hotpoint sales.

Mr. Schafer will continue to have his headquarters at the company's Chicago offices.

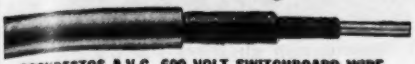
•

▶ V. D. PARROTT has been appointed lighting engineer of the Rome division of the Georgia Power Co., Atlanta. Before affiliating with the company, Mr. Parrott was assistant superintendent of city utilities for the City of Dalton. He replaces PAUL HARRISON, who resigned to become southeastern district lighting engineer of the Sylvania Electric Products, Inc., with headquarters in Atlanta.

▶ J. CALDER MUNRO, formerly assistant light and power sales engineer for the B. C. Electric Railway Co., Ltd., at Vancouver, has been appointed light and power sales manager to succeed the late E. E. Walker. At the same time

For Severe Conditions

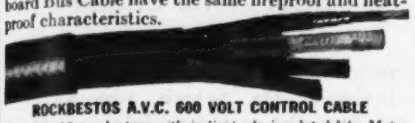
Permanently Insulated ROCKBESTOS Wires, Cables and Cords



ROCKBESTOS A.V.C. 600 VOLT SWITCHBOARD WIRE
(National Electrical Code, Type AVB)

Sizes No. 18 to No. 4/0 AWG with varnished cambric and impregnated asbestos insulation and gray, black, white or colored fireproof braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A.V.C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heatproof characteristics.



ROCKBESTOS A.V.C. 600 VOLT CONTROL CABLE

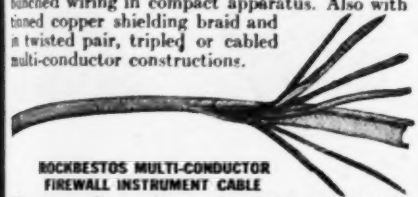
In one to 19 conductors with individuals insulated like Motor Lead Cable, cotton braid covered and cabled with an asbestos braid over all. Standard strandings AWG No. 12—19/#25 and No. 9—19/#22. Other strandings on order.

Designed for use in equipment requiring a multi-conductor control cable capable of withstanding high temperatures, this cable is widely used in the control systems of electric cranes manufactured for use in steel mills. The insulation is unaffected by heat, corrosive fumes, oil or grease and has ample moisture resistance.

ROCKBESTOS FIREWALL RADIO HOOKUP WIRE

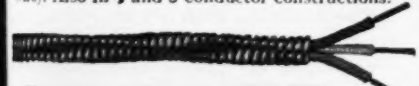
Size No. 22 to 4 AWG in 1000 volt rating, and No. 12, 14 and 16 AWG in 3000 volt insulated with high dielectric synthetic tape, impregnated felted asbestos and covered with color coded lacquered glass braid.

The first small diameter heat and flame resistant high-dielectric hookup wire, designed in 1937 and approved by the C.A.A. for use in airborne radio equipment. Widely used since in automotive and ground communications systems, electronic devices and apparatus. Operating temperature range 125° C. to minus 50° C. Ideal for small motor, coil, transformer and dynamotor leads and bunched wiring in compact apparatus. Also with tinned copper shielding braid and in twisted pair, tripled or cabled multi-conductor constructions.



ROCKBESTOS MULTI-CONDUCTOR FIREWALL INSTRUMENT CABLE

This unusually small diameter, light weight, high-dielectric 3 conductor No. 26 AWG cable, with individuals insulated like our Radio Hookup Wire, was designed for an electronic device in which three No. 22 AWG single conductor aircraft wires proved too bulky. It is made to a nominal diameter of .125" (smaller than a 14 AWG single conductor 1000 volt Rockbestos Firewall Radio Hookup Wire). Also in 4 and 5 conductor constructions.



ROCKBESTOS THERMOSTAT CONTROL WIRE

Sizes No. 14, 16 and 18 AWG in two to six conductors with .125", or .025" or (for 115 volt service) .031" of impregnated felted asbestos insulation and steel armor.

A multi-conductor control wire for low voltage intercommunicating, signal, and temperature control systems. Lifetime heatproof, fireproof insulation and rugged steel armor give troubleproof circuits.

ROCKBESTOS ASBESTOS INSULATED MAGNET WIRE

Round, square and rectangular asbestos insulated conductors finished to meet varying winding conditions and coil treatment requirements.

Protect your motors against heat-induced breakdowns with class B windings of Rockbestos Heat-Resisting Magnet Wire. Leads of Rockbestos A.V.C. Motor Lead Cable will complete the failure-proofing.

ROCKBESTOS APPARATUS HEATING CABLE

No. 19 AWG nickel-chromium resistance wire insulated with .040" of impregnated felted asbestos and covered with 4/64" waterproof lead sheath.

Manufacturers of photographic developing tanks, dry print developing machines, candy making equipment, soil heating cable kits and other devices requiring controlled distribution of mild heat can use this pliable heating cable to advantage. Also useful in preventing freezing of water pipes and congealing of oil, grease, ink, paint and sluggish fluids in conveyor pipes.

ROCKBESTOS 300 VOLT HEAT RESISTING FIXTURE WIRE
(Underwriters' Type AF)

Sizes No. 10 to 18 AWG stranded plain copper conductor insulated with black or white impregnated felted asbestos—with or without braid.

Rockbestos asbestos insulated fixture wires, approved by the Underwriters' Laboratories, are ideal for lighting fixture wiring because their heat resistant insulation will not bake out under the high socket temperatures developed in modern fixtures. Also used for small motor leads, miniature switchboards, business machines, radios, etc.

ROCKBESTOS ALL-ASBESTOS APPLIANCE LEAD WIRE

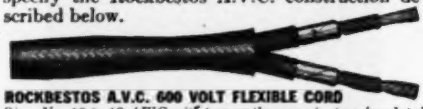
Sizes No 8 to 20 AWG solid or stranded copper, monel or nickel conductors insulated with .031" or .040" of impregnated felted asbestos in black, white or colors.

Whether you make waffle irons, hot-plates, small motors, ranges, water heaters, radios, ovens or blueprint machines, we can give you an asbestos lead wire made to fit the electrical and mechanical requirements of your product.

ROCKBESTOS ALL-ASBESTOS 600 VOLT FLEXIBLE CORD

Sizes No. 10 to 18 AWG with two or three conductors insulated with impregnated felted asbestos and covered with a heavy asbestos braid.

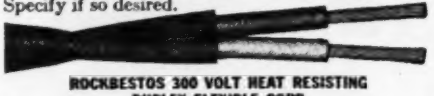
This heavy duty heat-resisting flexible cord is ideal for high wattage lighting units, apparatus, floodlights, etc., that are used in hot spots or develop heat in operation. For moisture resistant type specify the Rockbestos A.V.C. construction described below.



ROCKBESTOS A.V.C. 600 VOLT FLEXIBLE CORD

Sizes No. 10 to 18 AWG with two or three conductors insulated with impregnated felted asbestos, varnished cambric, felted asbestos and covered with a heavy impregnated asbestos braid.

For applications such as mentioned above in which heavy duty, high-dielectric, heat and moisture resistant flexible cord is required we recommend this construction with individual conductors insulated exactly like Rockbestos A.V.C. Motor Lead Cable. Approved for lighting applications, with polarized conductors, by Underwriters' as Style V flexible cord under a 300 volt rating. Specify if so desired.



ROCKBESTOS 300 VOLT HEAT RESISTING DUPLEX FLEXIBLE CORD
(Underwriters' Type AFPD)

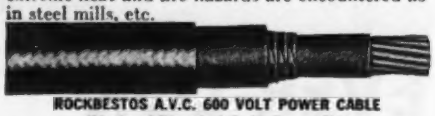
Sizes No. 10 to 18 AWG stranded plain copper conductors insulated with impregnated felted asbestos, polarized, twisted together and covered with a cotton braid.

This duplex heat resisting flexible cord is approved by the Underwriters' Laboratories for use in fixtures and is recommended for pendant types as the asbestos insulation will not dry out or crack at the socket. It provides protection against wire-failure, eliminates fire-hazard and gives permanent suspension as it does not deteriorate with heat or age. Also in twisted pair, tripled and triplex.

ROCKBESTOS A.V.C. 600 VOLT MOTOR LEAD CABLE
(National Electrical Code, Type AVA)

Size No. 18 AWG to 1,000,000 CM insulated with two walls of impregnated asbestos and a high-dielectric varnished cambric insert, with a heavy asbestos braid overall.

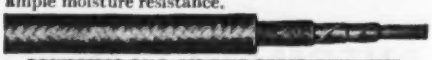
Heatproof, fireproof, greaseproof and oilproof, will not dry out and crack, won't burn or carry flame, and remains permanently flexible For coil connections, motor and transformer leads where extreme heat and fire hazards are encountered as in steel mills, etc.



ROCKBESTOS A.V.C. 600 VOLT POWER CABLE
(National Electrical Code, Type AVA)

Sizes No. 18 AWG to 1,000,000 CM insulated with laminated felted asbestos, varnished cambric, and asbestos braid Other constructions for service voltages to 5000.

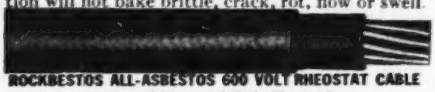
Use Rockbestos A.V.C Power Cable for the internal wiring and power leads of heat-exposed heavy electrical equipment and hot-spot wiring in conduit around boiler rooms, steam lines, furnaces, etc., as it withstands high temperatures and has ample moisture resistance.



ROCKBESTOS A.V.C. 600 VOLT BOILER ROOM WIRE
(National Electrical Code, Type AVA)

Sizes No. 18 to 8 AWG insulated with varnished cambric, impregnated felted asbestos and asbestos braid. Sizes 6 to 4/0 have another wall of impregnated asbestos next to the conductor

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A.V.C. construction is ideal. Its permanent insulation will not bake brittle, crack, rot, flow or swell.



ROCKBESTOS ALL-ASBESTOS 600 VOLT RHEOSTAT CABLE
(National Electrical Code, Type AI)

Sizes No. 18 AWG to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For flexible stranded conductor specify Rockbestos All-Asbestos Flexible Apparatus Cable. For solid conductor specify Rockbestos All-Asbestos Rheostat Wire.

A few of the National Electrical Code types and other constructions in the Rockbestos line of 125 different *permanently insulated* wires, cables and cords designed to give long-lived, dependable service under severe operating conditions — all built to resist such wire-destroying hazards as heat and moisture, oil, grease, corrosive fumes and flame. For complete information or samples, write to:

Rockbestos Products Corporation
986 Nicoll St., New Haven 4, Conn.

RESIST Heat, Moisture, Oil, Grease And Fumes WON'T Bake Brittle, Bloom, Burn or Rot

Heavy duty receptacle and plug

EVER-LOK
Receptacles, Connectors *and* Plugs

AUTOMATIC LOCKING

Ten (10) reasons why Ever-Loks are Standard Equipment in leading Industrial Plants where uninterrupted service is vital. →

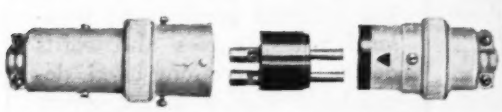
Ever-Lok protects against every contingency including abuse and frequent and hard usage.

For light and power circuits, 2, 3 and 4 poles, 10 to 200 Amperes.

For public address and control circuits 2 to 12 poles, 250 Volts.

Complete Catalog on Request.

1. Automatic locking
2. Positive grounding
3. Polarized
4. Metal clad
5. Full contact protection
6. Adjustable cord grip
7. Self-wiping, self-aligning contacts
8. Interiors precision moulded
9. Unit Assembly easy wiring
10. Fusible or non-fusible



New Ever-Lok Connector with midget fuses for high cycle tools and small portable equipment.

Since 1902 Please address Dept. No. B 37

RUSSELL & STOLL COMPANY

EXPLOSION-PROOF, WATER-TIGHT, INDUSTRIAL LIGHTING FIXTURES AND EQUIPMENT. AUTOMATIC LOCKING "EVER-LOK" CONNECTORS

125 BARCLAY STREET · NEW YORK 7, N. Y.

the appointment of H. A. ELLIOTT as director of power sales and that of R. HALL as director of lighting and residential services were announced. Mr. Hall is also secretary manager of the Electrical Service League of British Columbia, having maintained that work in the past in addition to his duties as illumination engineer for the company. A. GROKER, branch manager for the company at North Vancouver, has been made director of all branch offices.

•

D. F. Schmit to Direct RCA Victor Engineering

D. F. Schmit has been appointed director of engineering of the RCA Victor Division. Mr. Schmit, who was formerly assistant chief engineer, will fill the position vacated by Dr. J. B. Jolliffe, who recently was elected vice-president of the Radio Corp. of America in

D. F. Schmit

charge of RCA Laboratories. George L. Beers has been named assistant director of engineering in charge of advance development. He was formerly on the engineering administrative staff.

Mr. Schmit has held important engineering positions in the RCA Victor organization and its predecessor companies for more than fifteen years. Mr. Beers has been associated with RCA Victor and its predecessor companies since 1921.

•

► T. G. WHYTE has been appointed works engineer of General Electric's River Works plant, Lynn, Mass., in charge of general administration of the designing engineering divisions and the works laboratory, together with such other functions as may be delegated him by the manager. Mr. Whyte was born and educated abroad. He joined G. E. in 1910 on the turbine test at Lynn, later being assigned to transformer work. He was located at the

{Advertisement}

SYLVANIA NEWS
CENTRAL STATION EDITION

APRIL — *Published in the Interests of Better Sight and Sound* — 1945

Survey Reveals Strong Trend to Fluorescent Lighting in the Home

Owners Show Particular Interest in Kitchen, Living Room Installations

Preliminary reports of the impartial survey conducted by a leading market research organization—at the request of Sylvania Electric's Sales Research Department—indicate that the postwar era is likely to see a considerable expansion in residential use of fluorescent lighting.

To determine the public's interest in this type of illumination, more than 3,000 personal interviews were conducted. Of those interviewed, only about 10% now have fluorescent lighting, but almost half of these plan further installations after the war. Of the homes now without fluorescent lighting, 16% plan to install it in the future.

As a guide to utility lighting men in evaluating trends in home fluorescent lighting, the survey also covered public preference by room. Among those not having fluorescent, but planning to install it, the kitchen is the most popular room by a wide margin. (The chart below shows the relative percentages in this group.) Living room, bathroom, bedroom, dining room and basement follow in order.

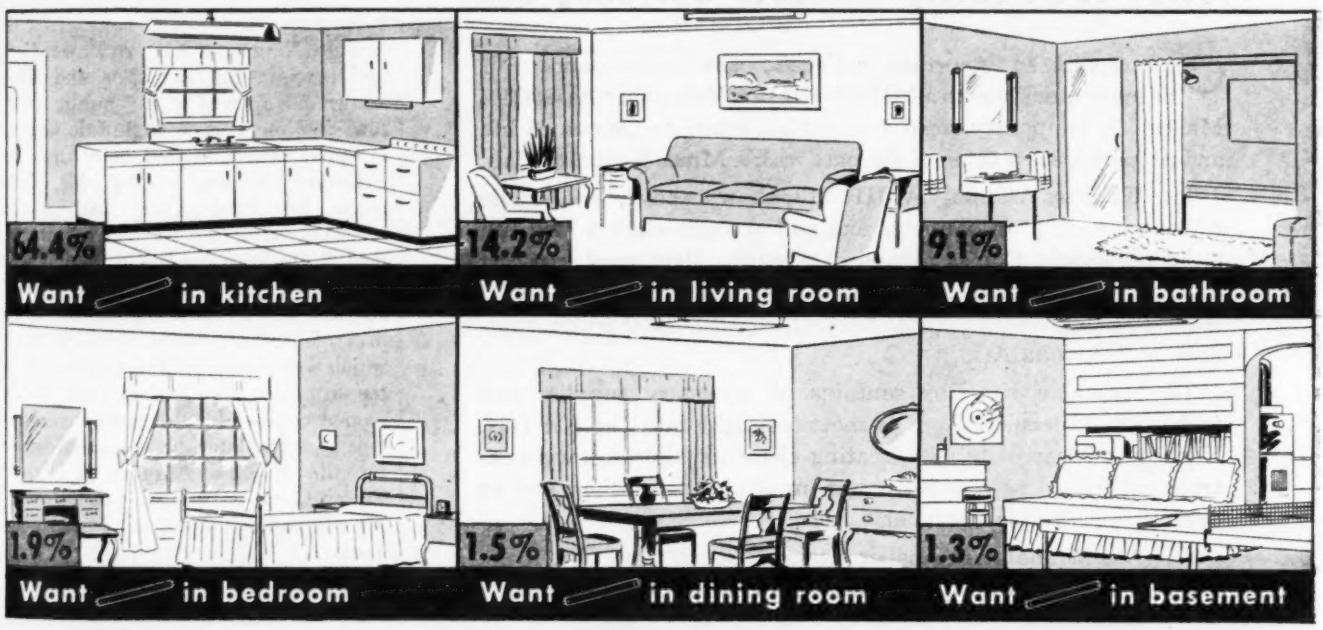
Among those now having fluorescent and planning additional installations, the kitchen also ranked first, with bathroom second and living room third. The order in the rest of the list was the same.

SYLVESTER SURVEY

"You plan to have fluorescent lighting in both the kitchen and bathroom. Now, how about the basement?"

DID YOU KNOW . . .

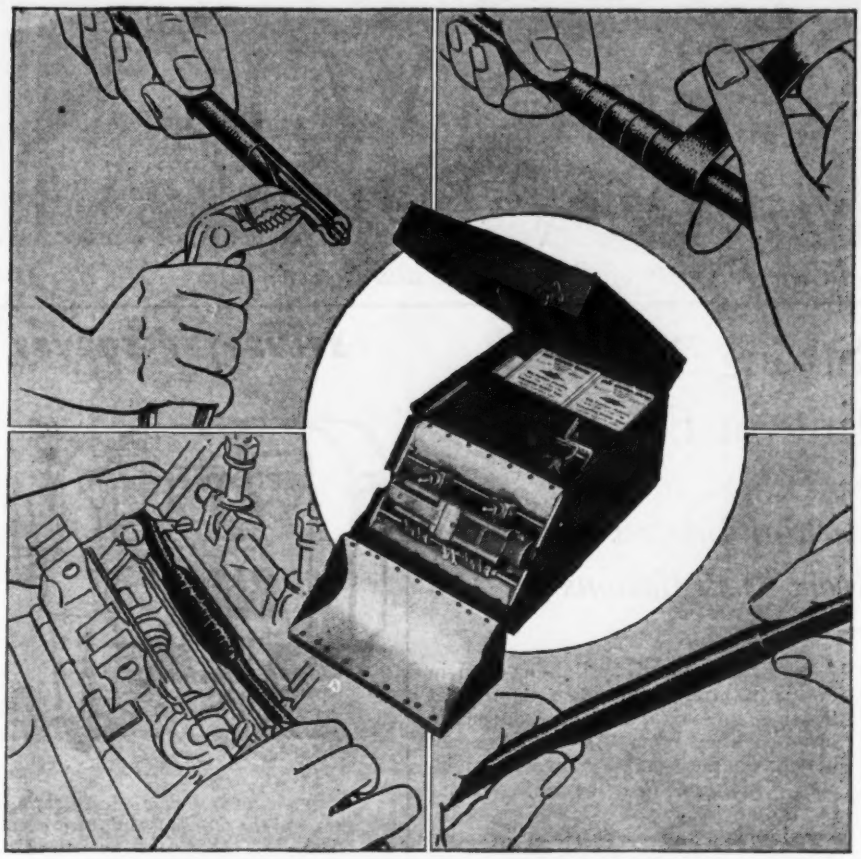
That 79% of the people having fluorescent lighting in their homes expressed themselves as *entirely* satisfied with it?



SYLVANIA ELECTRIC

SYLVANIA ELECTRIC PRODUCTS INC., Salem, Massachusetts

MAKERS OF FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; INCANDESCENT LAMPS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES



MINES KIT BOX
VULCANIZER ASSEMBLIES

Provide Cable Safety • Reduce Operating Costs

Cable repairs, so important in electric cable maintenance, can be made quickly with a MINES Kit Box Vulcanizer Assembly. Makeshift, temporary repairs to cables, often dangerous to life and property, are a thing of the past with a Mines Kit on the job.

The Kit Box Assembly VDIR 213, shown above, will handle cables up to 1⅜″ in diameter and will accommodate a mold up to 13″ in length. Comes packed in a sturdy, light steel carrying case, 23″ x 15¾″ x 13″, and weighs about 120 pounds. Easy to move to cable trouble. Total heating capacity 1200 watts, operates on 115 volts AC.

This portable Kit Box contains all necessary supplies and tools. The Vulcanizer itself is mounted right into the Kit Box. Each unit is complete with heating elements, thermostatic controls, cable holding clamps, power input cord, wrenches, and an operating instruction manual.

Also available in smaller size and Bench type. We also make Vulcanizers for all size cable and electrical conditions. Write for Bulletin RV-104K.

MINES EQUIPMENT COMPANY

4235 Clayton Ave., St. Louis 10, Missouri

Makers of the Connector with the Water-Seal

Pittsfield Works from 1917 to 1919, when he returned to the River Works to devote his time to street lighting transformers and associated equipment. From 1922 to 1929 he was designing engineer on the transformer job at Lynn, and then became managing engineer of the lighting division. Since 1942 he has been assistant to the manager in charge of engineering.

▶ A. J. YOUNG, district superintendent of the Virginia Electric & Power Co. for nine years, has been transferred to Fredericksburg as manager of the Fredericksburg district. THOMAS J. PECK, formerly connected with the Charlottesville office of the company, has been named to succeed Mr. Young.

▶ DR. HOWARD W. BARLOW has been elected dean of the school of engineering of the Agricultural and Mechanical College of Texas. He had been serving as acting dean of engineering since June, 1944, and prior to that was head of the department of aeronautical engineering.

▶ HARRY A. YOUNG, who has been connected with the California Oregon Power Co. in Medford since 1943, has been named advertising manager of that company.

OBITUARY

▶ WARREN TUBBS, chief counsel for the Buffalo, Niagara & Eastern Power Corp. and its operating companies, and widely known as an expert on public utility law, died on April 2 in Buffalo General Hospital, where he had been since last February. His age was 62. Mr. Tubbs began his legal career with a firm handling affairs of the Niagara, Lockport & Ontario Power Co. immediately after completing studies at law school. In 1911 he was named a partner in the firm of Strebel, Corey, Tubb & Beals, which was counsel to the utility. When the firm was dissolved in 1922 he was named counsel for the power company. Seven years later he became counsel for the Buffalo, Niagara & Eastern Power Corp. as well as for its operating companies throughout western New York.

▶ HENRY C. HAM, founder of the Delta Electric Co., Worcester, Mass., and later organizer of the Ham Electric Co. of that city, which was ultimately purchased by the Wetmore-Savage interests of Boston, died recently. At the time of his death he was assistant superintendent of public buildings at Shrewsbury, Mass.

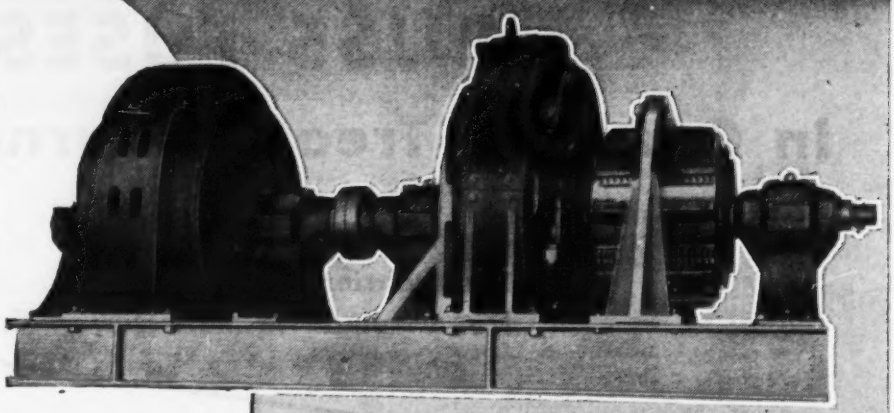
BURKE MOTOR GENERATOR SETS

BURKE for 54 years a builder of motors and generators in a wide range of types and sizes has the specialized experience to combine these units in M-G Sets to meet any current demand to 1000 K. W.

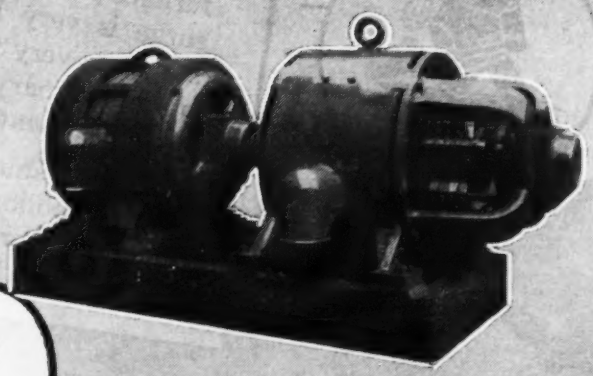
In addition to a standard line of M-G Sets both Synchronous and Induction motor driven, Burke also builds special combinations of A.C. to A.C.; D.C. to A.C.; or D.C. to D.C. Motor Generator Sets.

As each motor, generator application varies to meet individual sets of conditions it is good business to consult a specialist. Send your M-G problem to Burke.

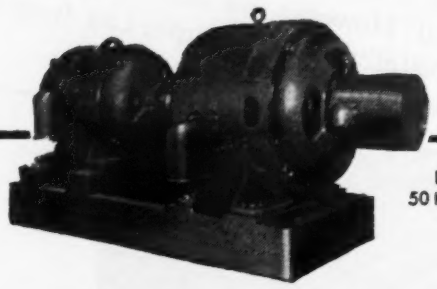
BURKE ELECTRIC COMPANY
ERIE, PENNSYLVANIA



Burke 1000 K. W. Motor Generator Set. 720 R. P. M. Synchronous Motor Driven.



Burke 75 K.W. Motor Generator Set. 1200 R. P. M. Induction Motor Driven.

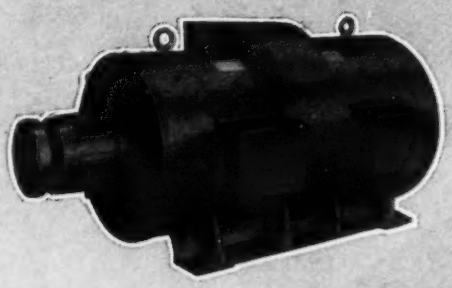


Burke 180 Cycle 50 K.V.A.; A.C. to A.C. M-G Set

BURKE PIONEERED THE HIGH CYCLE M-G SET

to furnish high frequency power with exceptionally good voltage characteristics for driving high speed tools. These sets are standardized in 6.25; 12.5; 25; 40; 50; 62.5; 75 and 93.8 K.V. A. Larger sizes built to special order.

Write for booklet No. 400.



Burke 15 K.W. Motor Generator Set. 1800 R. P. M. D. C. Motor Driven.

ARMY E NAVY

MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

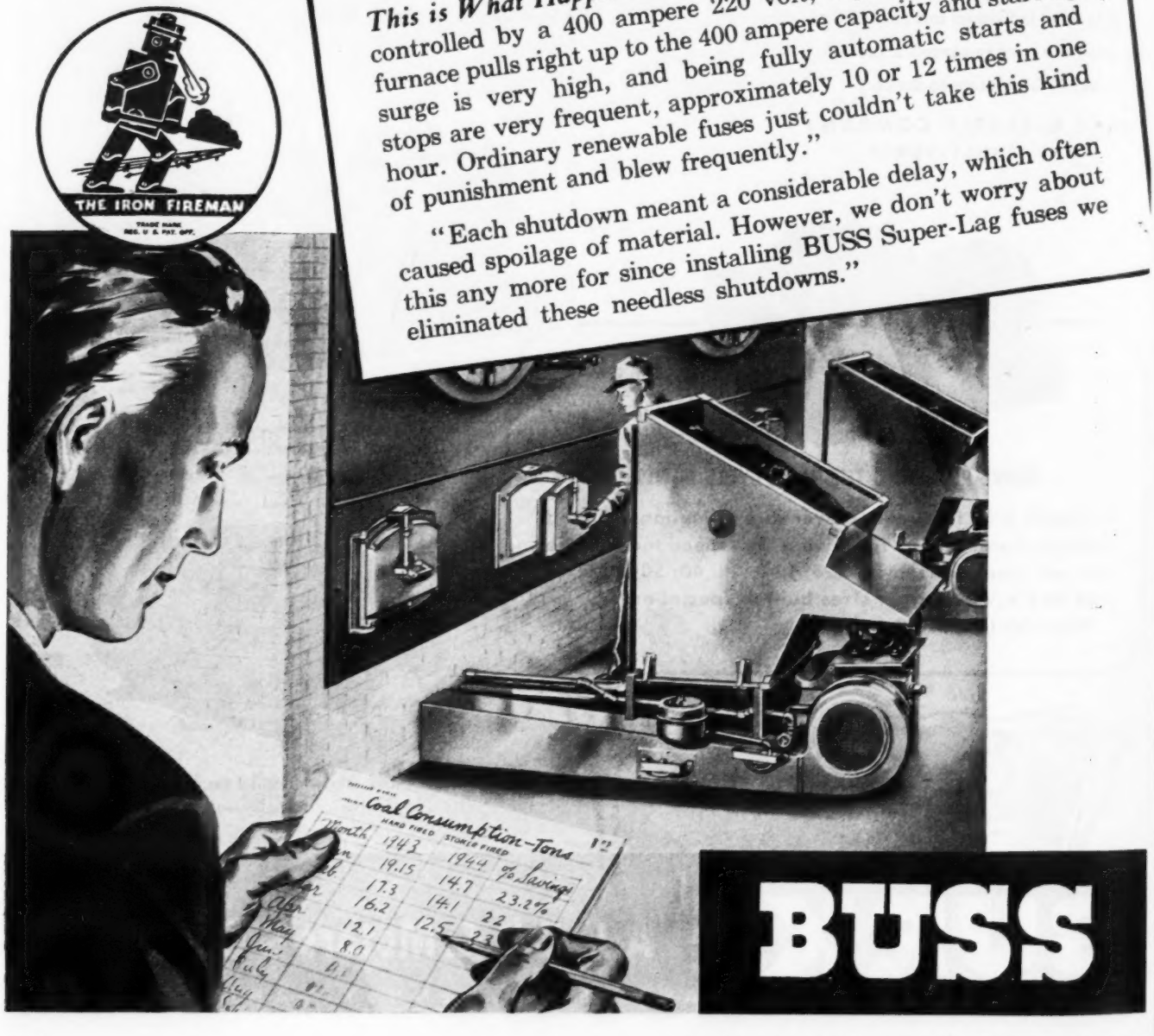
BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • Since 1891

"Material Spoilage Was Greatly Reduced When We Installed BUSS FUSES In Our Heat Treating Furnace Circuits"

—Mr. John Burchfield,
General Maintenance Supt.,
Iron Fireman Manufacturing Corp.

This is What Happened.. "In 1942 we bought a new furnace controlled by a 400 ampere 220 volt, 3 phase circuit. This furnace pulls right up to the 400 ampere capacity and starting surge is very high, and being fully automatic starts and stops are very frequent, approximately 10 or 12 times in one hour. Ordinary renewable fuses just couldn't take this kind of punishment and blew frequently."

"Each shutdown meant a considerable delay, which often caused spoilage of material. However, we don't worry about this any more for since installing BUSS Super-Lag fuses we eliminated these needless shutdowns."



BUSS

Why BUSS Fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of shutdowns caused by needless fuse blows.

Prevent future trouble in your plant —by doing this today

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MFG. CO., ST. LOUIS 7, MO.
Division McGraw Electric Company

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES
in the design of the FUSE-CASE help make it possible
and

***The* SUPER-LAG**
development in the FUSE-LINK completes the job.

Super Lag FUSES

SOLD THROUGH WHOLESALERS

MANUFACTURING MARKETS

Formica Reports Huge Output, Expansion

Current production of the Formica Insulation Co., Cincinnati, continues to go into vital war applications with contracts and orders received during the past month the largest in two and one-half years, D. J. O'Conor, president, informed stockholders of the company at the recent annual meeting, adding that "immediate prospects and the post-war period are most encouraging."

Based on inquiries already received by the company, O'Conor stated, "there is every indication that demands for laminated materials such as we make, will be greater in post-war than in the pre-war era." Research and engineering developments completed during the war will provide new post-war applications, particularly in the decorative and transportation fields, he said.

With wartime production operations continuing at top speed additional factory space involving three floors is being provided through construction at the plant in Cincinnati. The company is also leasing an entire building located at 1002 Gilbert Avenue in an industrial section adjacent to the downtown business district for storage purposes.

•

Industrial Cooperation Gets Things Done

One Friday night recently, fire destroyed the entire McLaughlin Co.'s machine shop, Piqua, O., just when Lear, Inc., was relying on some on-schedule production of certain machine parts that were absolutely essential to an important aircraft contract due for delivery within a few days. Serious delay was avoided by using all of Lear's maintenance crew, as well as the entire McLaughlin staff working through the week-end.

All of the test equipment and production fixtures and jigs were ripped out of the smouldering plant, moved into space that was hurriedly prepared in the basement of one of the Lear buildings and quickly repaired or rebuilt, where necessary, so that production in the basement quarters could start the following Monday morning. The McLaughlin company moved into its old quarters as soon as they were put back in condition.

•

New Process Effects Mass Output of Bridge Parts

Lincoln Electric Co., Cleveland, has perfected a process of automatic carbon arc welding by which aluminum parts for military bridges can be fabricated on a mass scale. The welding equipment used for this high production project is a Lincoln product known as the "Electronic Tornado."

The process has been so successfully applied to the production of aluminum parts for special military bridge structures that 35 engineers representing 14 different firms from nine states have attended a special course on the application of the "Electronic Tornado" in the automatic welding of aluminum at the Lincoln plant.

Elliott Orders Rise 18 Percent in '44

Net value of shipments of Elliott Co., after estimated refund for renegotiation, reached an all-time high in 1944, Grant B. Shipley, board chairman and president, announced in the company's annual report.

Deliveries of power plant equipment and accessories, including large turbine generator units and main propulsion motors for Maritime Commission ships, amounted to $27,078,289, as compared with shipments of $24,621,819 in 1943. All four of the company's manufacturing plants (at Jeannette and Ridgway, Pa., Springfield, Ohio and Newark, N. J.) established new production records.

Orders entered during 1944 were $15,511,242, as compared to $13,106,581 for 1943, an increase of 18 percent. Unfinished business aggregating $22,077,944 was carried forward. Net income for 1944, after providing for renegotiation, all taxes and a contingency reserve, was $622,690, equal to $2.56 per share of common stock. This compares with a net profit of $672,207 in 1943.

•

Paranite Changes Name

The name of Paranite Wire & Cable Corp. has been changed to Paranite Wire & Cable Corp., Division of Essex Wire Corp., 14310 Woodward Ave., Detroit, Mich.

NEW D.C. MOTOR TEST FLOOR OPERATING—As many as 40 d.c. machines a day can be tested on this modern test floor recently put into operation at Allis-Chalmers' Norwood, Ohio, Works. Eleven test bases and rig machines ranging from 10 to 250 hp. are available. A tandem testing rig operating with a 250 hp. motor and combination sheave coupling provides for testing four 250 hp. motors fully loaded in tandem Dead front switchboards are used and equipped with voltage regulators

•

CONTINENTAL DIAMOND ENGINEERED *Plastic Materials*

The part illustrated is an airborne radio insulating part . . . made from grade "L" DILECTO . . . a laminated phenolic plastic. It was sawed, milled, drilled, countersunk and tapped. Tolerance requirements were close. DILECTO parts such as this one will be widely used in all branches of air transportation.

Here is a strong, tough plastic . . . with high electrical insulating properties that remain stable under extremes of temperature and humidity. DILECTO is readily fabricated on ordinary metal working tools. It is NON-corrosive and highly resistant to many chemicals.

This versatile plastic may be the answer to your "What Material?" problem. C-D technicians will be glad to help you find out. Their wealth of "Know-How," the result of a half century of service to industry, makes available to you thousands of case histories of solved design and operational problems.

KG-45

C-D PRODUCTS

The Plastics

DILECTO—A Laminated Phenolic.
CELORON—A Molded Phenolic.
DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.
HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE
VULCOID—Resin Impregnated Vulcanized Fibre.
MICABOND—Built-Up Mica Electrical Insulation.

Standard and Special Forms

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

Descriptive Literature

Bulletin GF gives Comprehensive Data on all C-D Products. Individual Catalogs are also Available.

DISTRICT OFFICES
NEW YORK 17 • CLEVELAND 14 • CHICAGO 11
SPARTANBURG, S. C. • SALES OFFICES IN PRINCIPAL CITIES

WEST COAST REPRESENTATIVES
MARWOOD LTD., SAN FRANCISCO 3

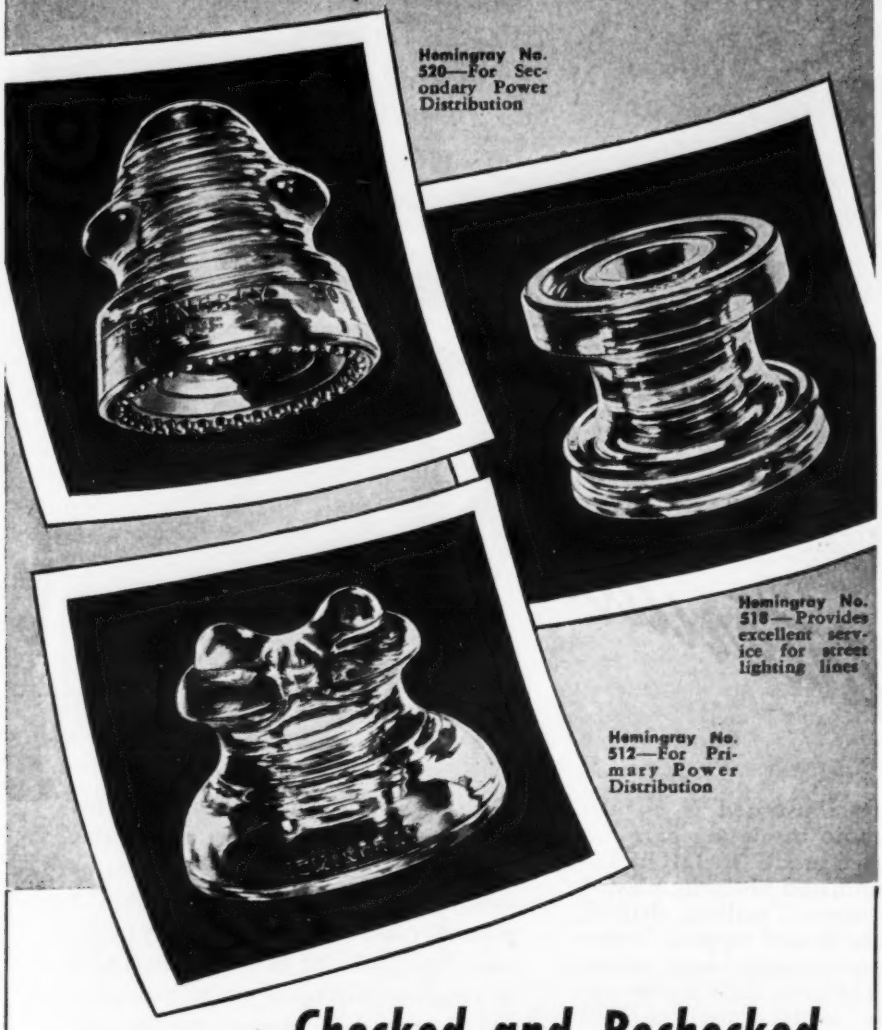
IN CANADA:
DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO 8

Continental-Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911—NEWARK 15 • DELAWARE

HEMINGRAY INSULATORS

Favorably Known Since 1870



Hemingray No. 520—For Secondary Power Distribution

Hemingray No. 518—Provides excellent service for street lighting lines

Hemingray No. 512—For Primary Power Distribution

Checked and Rechecked

. . . All Along the Line!

Hemingray Insulators are made under careful supervision—under exacting step-by-step quality production control. That's why they're so *tough* and *strong*—so *dependable*.

Try them! The cost is low to begin with—lower in service-life.

There are ten Hemingrays for Primary Power distribution for voltages from 2,300 to 15,000 and manufactured in accordance with suggested specifications of the Edison Electric Institute.

There are ten Hemingrays for Secondary Power distribution with Heights ranging from $2\frac{15}{16}$ to $5\frac{1}{32}$ inches and Diameters ranging from $2\frac{1}{4}$ to $3\frac{1}{4}$ inches.

Investigate! Hemingrays are sold by principal jobbers and are manufactured by Owens-Illinois, Hemingray Division, Muncie, Ind.

OWENS-ILLINOIS

HEMINGRAY INSULATORS

Telephone-Telegraph

Export Agents: International Standard Electric Corporation, New York City

Manufacturers Issue Earnings Reports

Among the electrical manufacturing companies recently issuing earnings reports are the following:

SQUARE D—For 1944, net profits, $1,919,083, equal to $4.36 a common share, after reserve for renegotiation, compared with 1943 net, after renegotiation settlement, of $2,186,505, or $4.98 a common share.

MCGRAW ELECTRIC—For 1944, net income, subject to renegotiation, and after $1,421,142 provision for taxes on income, was $888,894 on net sales of $10,923,312, compared with net income of $998,587, after $1,225,500 taxes for 1943, when sales totaled $9,503,386.

HOLOPHANE CO.—Six months to December 31, net profit, $71,128 or 71 cents a common share, compared with $102,066, or $1.01 a common share for similar period of 1943.

SANGAMO ELECTRIC—For 1944, net profit $547,383, equal to $1.96 a common share, compared with $555,727, or $2 a share in 1943.

•

Westinghouse Changes Names of Radio Units

Official changes in names of two divisions of the Westinghouse Electric & Manufacturing Co., to better describe their expanding functions now and post-war, have been announced.

Involved in the changes are the former radio division, which now becomes the industrial electronics division, and the former radio receiver division, which becomes the home radio division. Each will continue under its present direction—C. J. Burnside, for the past three years manager of the radio division, will head industrial electronics, and Harold B. Donley, named manager of the radio receiver division at its organization last year, will head the home radio unit.

Announced at the same time was removal of the home radio division from temporary quarters in Baltimore to a permanent location in Sunbury, Pa.

•

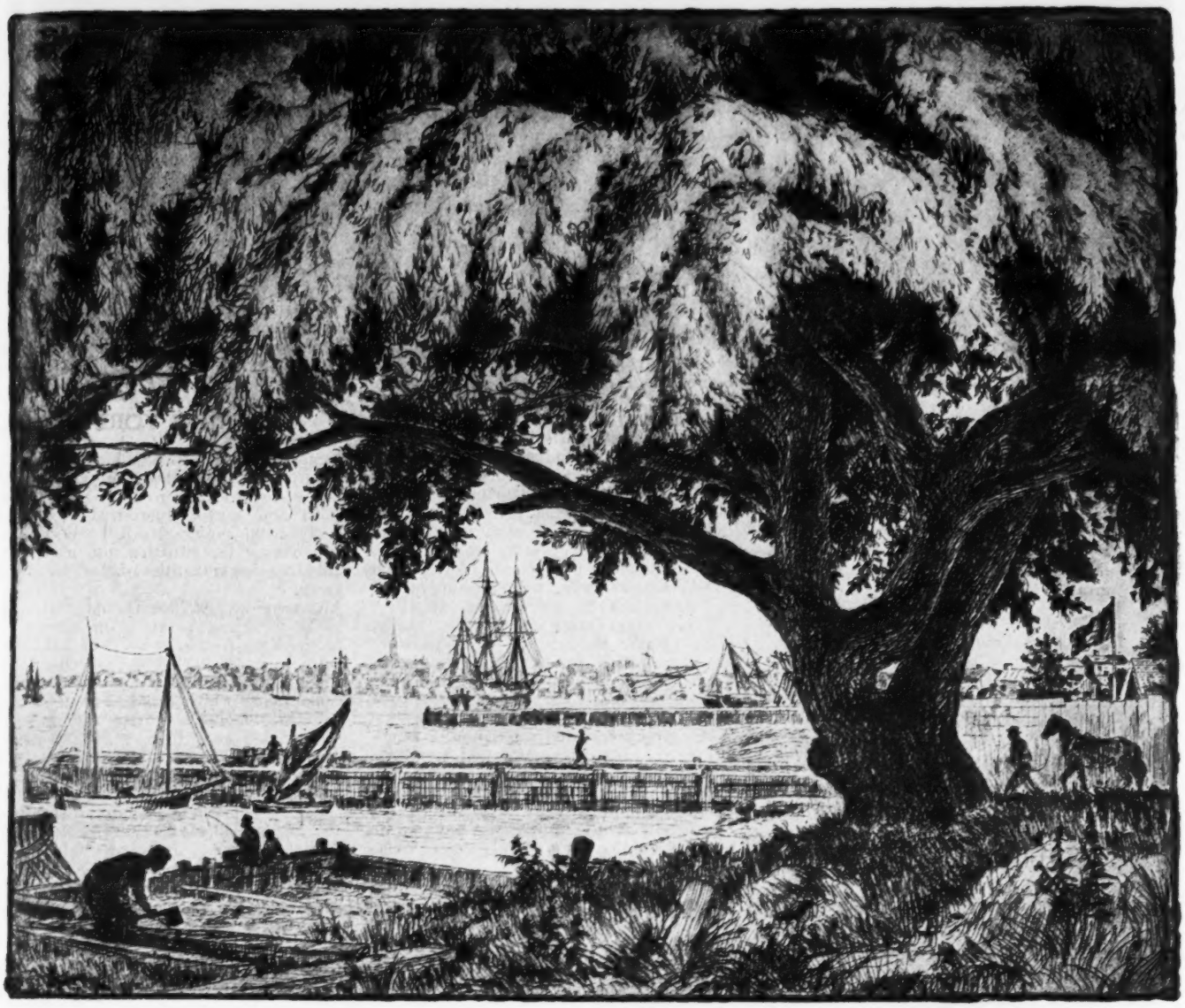
Allis-Chalmers Dividend

Directors of the Allis-Chalmers Manufacturing Co. have declared a 40-cent dividend on the common stock, payable on March 31. Last year payments of 25 cents each were made in March, June and September and one of 90 cents in December.

•

Announces $12,000 Budget

A $12,000 budget for 1945 has been announced by the RLM Standards Institute. Of this amount $4,000 will be used for the incandescent program, $8,000 for the fluorescent program.



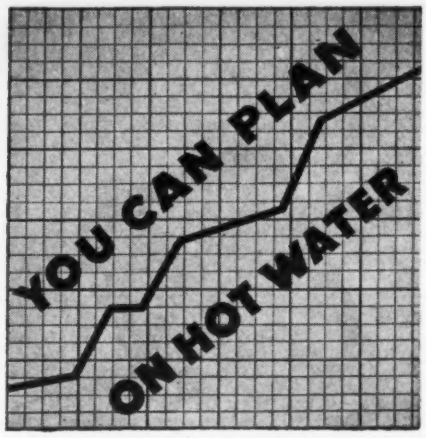
WILLIAM PENN TREATY ELM

In 1682 on the shore of the Delaware River, under the spreading limbs of an elm tree, William Penn made a treaty with the Indians (the only treaty between those people and the Christians that was not ratified by oath and was never infringed). This tree today is known as the William Penn Treaty Elm.

Today the making of treaties has moved indoors, where modern improvements such as electric lights and telephone communication facilitate the work. Life in general, however, is certainly made more pleasant by trees.

Maintenance of the beauty of trees and uninterrupted power and communication facilities so greatly needed in modern life, has been the aim of the Asplundh Tree Expert Company for the past seventeen years.

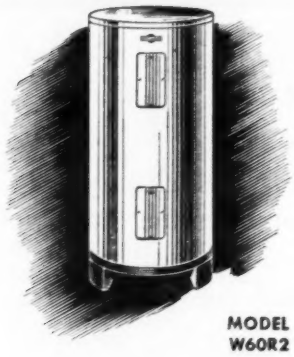
ASPLUNDH TREE EXPERT CO.
JENKINTOWN • PENNSYLVANIA



● FOR POSTWAR LOAD BUILDING

There will be a rich market for automatic hot water facilities in the postwar period. In fact, it is estimated that the demand for electric water heaters alone will total more than a million units!

Public utilities can reap double benefit from this market by satisfying this demand and at the same time building their off-peak load. Electromaster Water Heaters can best meet both requirements. Made by a specialist in electric water heaters and ranges, Electromaster Water Heaters offer a low-cost product with consumer appeal. Built to exacting specifications, they assure a dependable service-free load building addition to your line.



MODEL W60R2

ELECTROMASTER WATER HEATERS

are laboratory inspected and approved for long, service-free performance.

ELECTROMASTER INC.
1811 E. ATWATER
DETROIT 31, MICHIGAN

Field Reports on Business

With continued successes of Allied armies throughout the world, Federal agencies have acted to halt the belief that reconversion can follow V-E Day. Indications are that all price and material controls will be kept for an indefinite period, and that reconversion will come slowly despite the fact that cutbacks are now being made in government orders.

CHICAGO

Reflecting the demand for increased war production, new plants announced or under way in the Chicago area represent, during March, investments of $23,313,271. This figure also includes several post-war commitments and brings to $30,360,271 the value of industrial developments announced during the first quarter of 1945.

Standard Oil of Indiana will build adjacent to its refinery at Whiting, Ind., one of the five additional 100 octane gasoline plants to be constructed, under proposals of the Petroleum Administration for War, to meet rising military needs. Standard will build a similar new plant at its Sugar Creek, Mo., refinery. Current construction will be carried out with private capital.

The Naval Ordnance Unit at nearby Forest Park, Ill., operated by Amertorp Corp., a unit of American Can Co., is undergoing an expansion program involving construction of several new buildings.

Commonwealth Edison Co. has received WPB approval for its installation of a new 107,000-kw. turbo-generator and two associated 600,000 lb. per hr. steam generating units at Calumet station here. Orders for the equipment have already been placed but completion of the project is expected to take 20 months. Cost of the project to be about $12,900,000.

Interstate Power Co., Dubuque, Iowa, has announced plans for construction of a new 15,000-kw. power plant costing $2,000,000 adjoining the du Pont cellophane plant at Clinton, Iowa.

PACIFIC COAST

Pacific Coast electrical business is comparatively little affected by the approach of V-E Day because, instead of diverting many local industries to peacetime production, that day will step up the Pacific war. Stock conditions are somewhat easier especially in synthetic wire and rigid iron conduit staples, and the sizable quantities of varied electrical items, required by such service branches as the engineers, are being well handled.

Many orders covering fractional and integral motors for irrigation are reported, typical being 800 fractional, 500 sizes 1 to 3 hp. inclusive, and 420 sizes 1 to 5 hp. besides 15 sizes 5 to 40 hp. for a lumber mill. Fairbanks Morse has bought 100 G.E. motors of 5 to 15 hp.

Oregon has budgeted $3,400,000 for 10 state institutions during 1945 and the Reno, Nev., area will vote on a $750,000 hospital bond issue. San Francisco Bay area industrial payrolls have decreased about 12½ percent from last year with about 9 percent decrease in their workers, while both registered 9 percent increase in the wholesale trade. San Francisco is buying trolley wire armatures and field coils for its municipal railway. Los Angeles is buying circuit breakers and parts.

Industrial developments include a lumber plant at Oroville, Calif. with 50,000,000 board ft. annual capacity, plans for a $6,000,000 sulphate plant upon Vancouver Island, $1,000,000 expansion of Aerojet Eng. Corp. at Azusa, Los Angeles County with RFC aid, a $1,650,000 carbon black plant at Monument, N. M., and construction begun upon the Heinz Co.'s factory at Tracy, Calif.

NEW YORK

Steel backlogs continue high despite cancellations on government orders. The fact that many orders now on the books are for third and fourth quarter delivery leads many in the industry to feel that V-E Day will change the situation and make available immense quantities of steel for civilian needs.

Construction in the United States, last week according to statistics released by *Engineering News-Record*, was $33,709,000 down from $37,301,000 the preceding week. The big decrease was due to that in Federal construction which dropped from $28,234,000 to $18,911,000. State and municipal construction rose from $4,900,000 to $9,621,000, an increase of 96 percent. Construction for the corresponding week of 1944 was $33,963,000.

Private construction for the first quarter, 1945, was $113,444,000, 15 percent higher than the corresponding quarter of 1944, but public work fell 24 percent to $266,763,000. Total construction for the quarter was $380,207,000, 16 percent below the $450,122,000 reported for the first quarter, 1944.

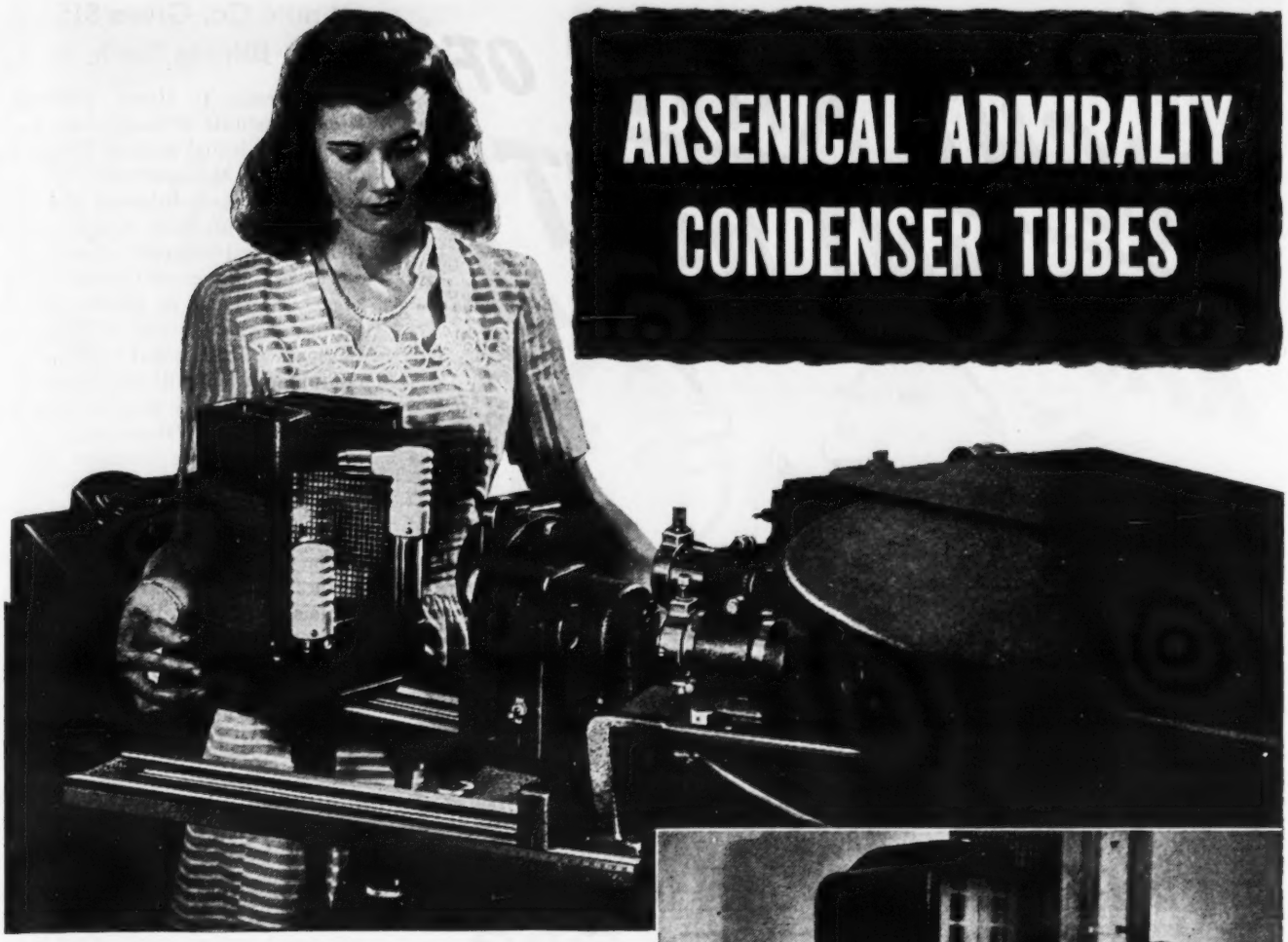
NEW ENGLAND

Orders issued by the government for full speed ahead on a number of construction jobs as well as for those concerned with change-over into new types of war materiel production have resulted in an increased demand for industrial power equipment and for switches, control apparatus, and panelboard supplies, the latter on a fairly large scale. One order for switching equipment recently placed totaled about $65,000; others range from $10,000 up. Small motor sales are steady; fluorescent fixtures are in demand, and modernization in Boston retail district is moving ahead at an accelerated pace.

Activity in Connecticut is encouraging. Large orders of machine tool bearings were placed last week with nationally known companies. One order involving $126,379 was received by New Departure Div., General Motors, Bristol; and another company was awarded a contract to supply the Navy with $116,034 worth. One Connecticut manufacturer submitted bids for 2,800 electric irons; brass tubing and wire orders received by American Brass and Bridgeport Brass companies are increasing. A Boston manufacturer submitted bids on over 5,000 electric heaters, and the demand for lighting supplies needed in ship repair work is good.

Other orders received in this area last week include relay apparatus, $57,820 Hunt Mfg. Co., Hartford, Conn.; ignition protection, Bolton Mfg. Co., New Haven, and Chandler Evans Corp., South Meriden.

ARSENICAL ADMIRALTY CONDENSER TUBES



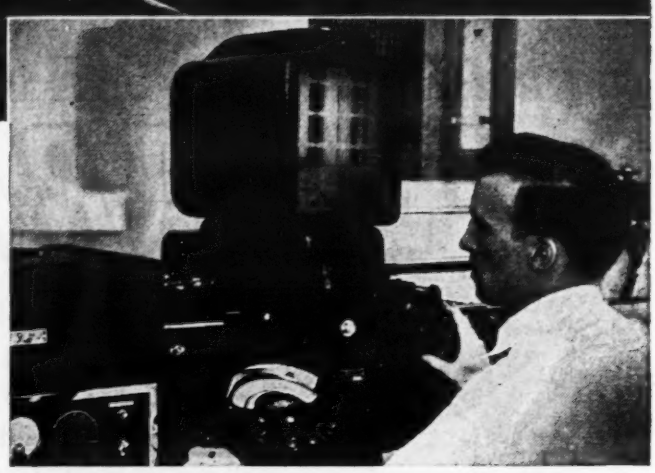
An improved alloy with high resistance to dezincification

NOT a "cure-all," but a tube alloy to consider if you are troubled with dezincification. The American Brass Company has been manufacturing Arsenical Admiralty Tubes on a commercial basis since 1934, and now furnishes this alloy as standard for Admiralty Tubes*.

This alloy was the result of studies of the effect of small quantities of arsenic introduced in brass alloys as an inhibitor of dezincification.

The consistently satisfactory performance of Arsenical Admiralty Tubes, over the past 11 years in many types of service has substantiated the results of laboratory tests.

While Anaconda Arsenical Admiralty Condenser Tubes have been quite generally used, they are especially well-adapted to those installations in which the older alloys showed definite tendencies to dezincify.



(At top) grating type spectrograph used to determine Arsenic content in Arsenical Admiralty Condenser Tubes. (Above) Densitometer-Comparator used to read spectra taken on the spectrograph.

TECHNICAL SERVICE AVAILABLE

It is a function of the engineers of our Technical Department to assist Condenser Tube users in the selection of the most economical tube alloy for any given set of operating conditions. Feel free to call on us. Publication B-2, sixth edition, giving detailed information on Condenser Tube and Tube Sheet Alloys mailed on request. 43120

Admiralty Alloy Tubes without arsenic will be furnished only when so specified.

ANACONDA

Anaconda Condenser Tubes

THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

KEEP FAITH WITH YOUR FIGHTERS AND YOURSELF! BUY WAR BONDS FOR KEEPS

IT'S THE RIGHT KIND OF RADIANT HEAT!

INFRA-RED

EQUIPMENT MANUFACTURERS and PAINT MAKERS CAN AGREE ON

PENETRAY

No longer is "passing-the-buck" a game to be played by paint men versus equipment men. No longer is the "buyer" in the middle as to whether paint or equipment is responsible for unsatisfactory results.

Penetray's exclusive ceramic coating improves wavelength, producing more intensive color, thorough curing and superior polymerization on metals. In addition, insect attraction is minimum because glare is reduced and improved uniformity of energy distribution results. Prove these points. Make your own tests for color and gloss; for corrosion and abrasives.

SALES ENGINEERS WILL CALL or DETAILS on REQUEST

LEARN TO SAY
»PENETRAY

VERD-A-RAY
CORPORATION :: TOLEDO 5, OHIO

Ohmite Co. Gives $15,000 to Illinois Tech. for Lab

Dr. Henry T. Heald, president of Illinois Institute of Technology, has announced an initial grant of $15,000 from the Ohmite Manufacturing Co. to be used for the establishment of a laboratory for the precision measurements of electrical and magnetic quantities.

The gift was given through David T. Siegel, president of Ohmite Manufacturing Co. and a trustee of Illinois Tech. It represents the initial contribution for equipping what will be known as the Ohmite Laboratory for Precision Measurements. The laboratory's ultimate goal is to provide precision electrical measurements for the Chicago area approaching in accuracy those of the Bureau of Standards in Washington, D. C.

The laboratory itself will be located at the Armour Research Foundation of Illinois Institute of Technology and will be developed under the direction of Prof. E. H. Schulz, supervisor of electrical engineering laboratories, and L. W. Matsch, supervisor of electrical engineering in the Armour Research Foundation.

•

Local Quits Union Council

United Electrical Radio and Machine Workers of America, Local 130 (CIO) has voted partial disaffiliation from the Maryland-District of Columbia Industrial Union Council but will retain a token membership. Three other non-electrical unions had previously withdrawn from the council.

The local is composed of workers of the Westinghouse Electric & Manufacturing Co. plants in Baltimore. The president of the local said that the action was taken because the council is being run by a clique.

•

Hytron Changes Name

Hytron Corp., Salem, Mass., has changed its name to Hytron Radio & Electronics Corp., of the same city. Bruce A. Coffin has been elected president and general manager; Lloyd H. Coffin, treasurer and board chairman; Edgar M. Batchelder, executive vice-president; and Charles F. Stromeyer, vice-president and director of engineering.

•

Freon Restrictions Lifted

Restrictions on the delivery and use of Freon 12, used in air conditioning systems, have been removed by the War Production Board. More essential users, however, still have first priority.

Announcing—

the SECOND U. S.-made "Megger" Instrument ... THE MIDGET "MEGGER"* INSULATION TESTER

Following the production, in June 1943, of the first U. S.-made "Megger" testers, we now announce a second "Megger" instrument being built in our Philadelphia factory—the Midget "Megger" Insulation Tester.

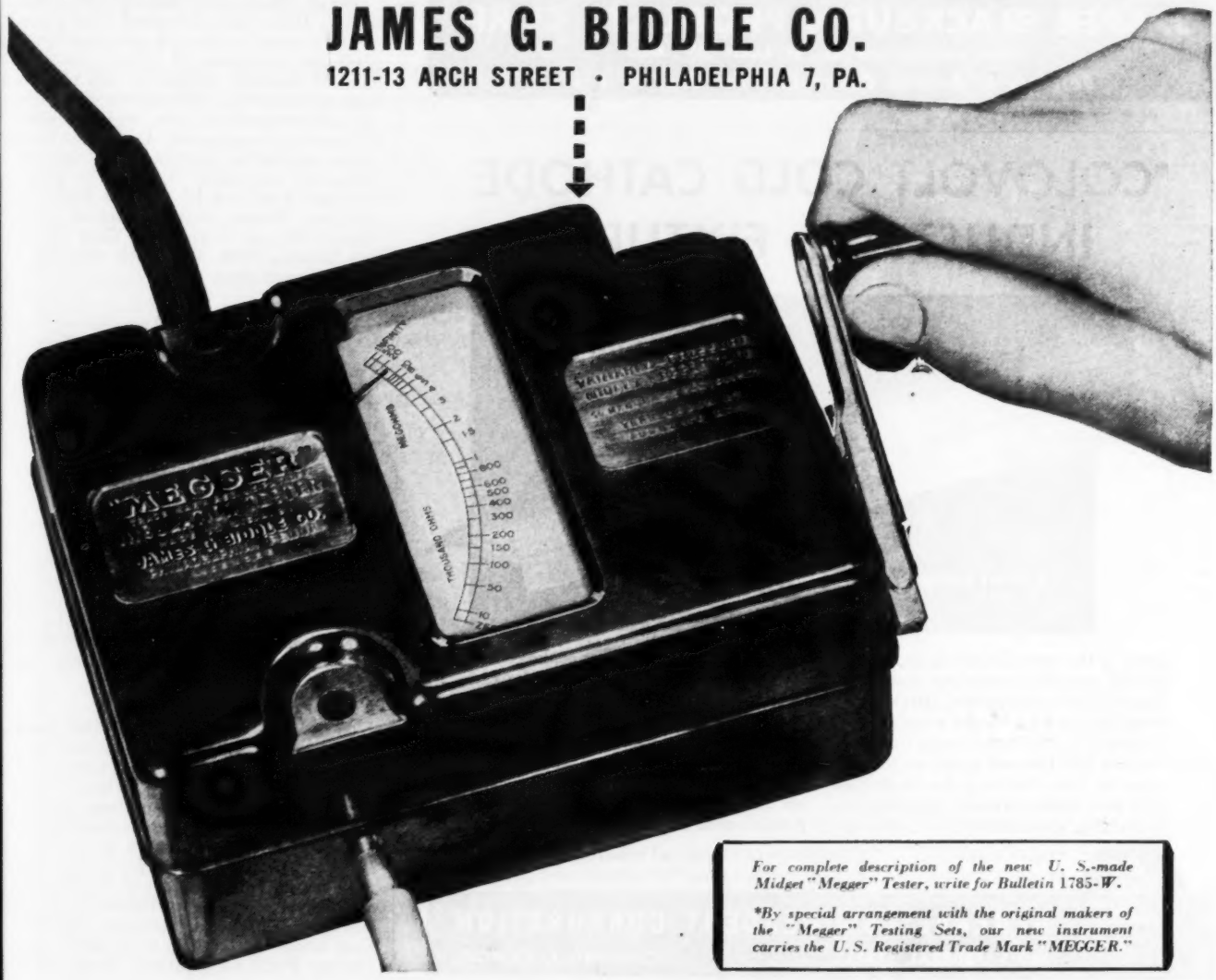
This new U. S. model is identical in design and similar in every way to the Midget "Megger" Insulation Testers we have been supplying for the past ten years, except that the molded plastic housing is mottled brown instead of red.

The Midget "Megger" Tester has achieved wide popularity because of its size and low cost. Weighing but 3 pounds, it is always ready to use for testing insulation resistance of a wide variety of electrical equipment. It is indispensable for maintenance and trouble shooting, even where higher range "Megger" testers can be used . . . reads up to 50 megohms and delivers 500 volts d-c from a hand-cranked generator, making it independent of batteries or external power supply. Lower ratings are also available.

Manufacturing facilities are complete and our expanding production makes availability of these new instruments far better than we have previously been able to offer. We invite your orders for them.

JAMES G. BIDDLE CO.

1211-13 ARCH STREET • PHILADELPHIA 7, PA.



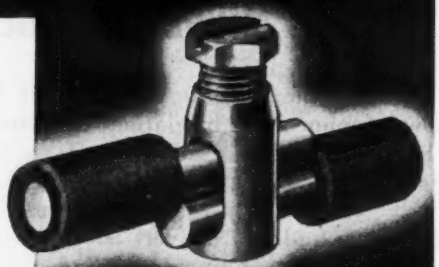
For complete description of the new U. S.-made Midget "Megger" Tester, write for Bulletin 1785-W.

**By special arrangement with the original makers of the "Megger" Testing Sets, our new instrument carries the U. S. Registered Trade Mark "MEGGER."*

For Service Entrance Connections

We Find BLACKBURN "GRIPITS" Are the Strongest

BLACKBURN "GRIPITS" are made of DURONZE, a high-strength silicon bronze that's 75% stronger than hard-drawn copper. Circular construction gives extra strength. "GRIPITS" will not stretch or distort when tightened—will not come loose. Then, too, BLACKBURN "Gripits" are more economical for this purpose.



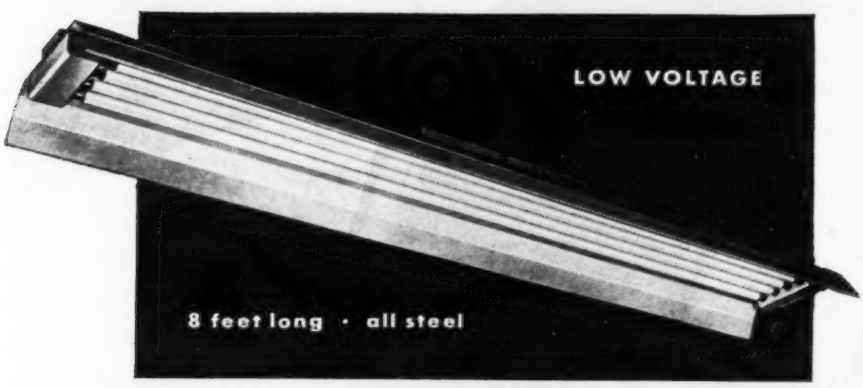
Over 100 Conveniently-located Jobbers' Stocks

JASPER BLACKBURN PRODUCTS CORP.

Main and Clinton Sts., St. Louis (6), Mo.

Builders of Quality Connectors for Over 10 Years

*COLOVOLT COLD CATHODE INDUSTRIAL FIXTURES



Here is the new Colovolt industrial fixture, one of a complete line of industrial and commercial "packaged" units. Equipped with the standard 93" Colovolt 10,000 hour lamp, Colovolt fixtures may be used singly or in continuous line lighting in multiples of 8 feet. Instantaneous starting, no flickering, guaranteed for 1 year except for failure due to breakage are extra advantages of the Colovolt Cold Cathode low voltage fluorescent lamp. The long life expectancy of Colovolt lamps may be realized even when constantly turned on and off, and *pre-scheduled re-lamping, with no loss of production or time, is now possible with Colovolt installations.*

*Trade mark registered U. S. Pat. Off.

Contact your electrical wholesaler or jobber, or write us for full details and prices.

General LUMINESCENT CORPORATION

GENERAL LUMINESCENT CORPORATION

660 S. FEDERAL STREET CHICAGO 5, ILLINOIS

Sales Opportunities

MARYLAND—Consolidated Gas, Electric Light & Power Co., Baltimore, plans extensions and improvements in power substation with installation of additional equipment for increased capacity. Work is scheduled to be carried out at early date.

NEW YORK—Bureau of Yards and Docks, Navy Department, Washington, D. C., will have plans prepared soon for improvements in power plant at Brooklyn Navy Yard, with installation of equipment for increased capacity and replacements. Cost about $195,000. Also will build new public works garage and repair shop at yard, to cost approximately $730,000, with mechanical and electrical equipment. Projects are included in budget for coming fiscal year.

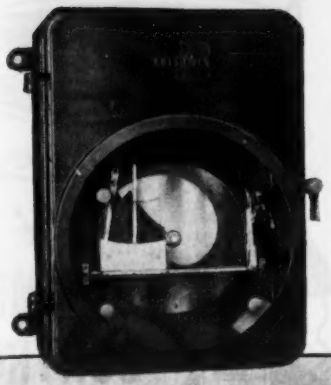
PENNSYLVANIA—Mack Trucks, Inc., Empire State Bldg., New York, N. Y., has plans for large plant for production of motor trucks for government by Mack International Motor Truck Corp., operating subsidiary. It will comprise several one-story buildings, estimated to cost about $500,000, with machinery and electrical equipment. Financing by Defense Plant Corporation. Work on superstructure will begin soon.

TEXAS—Phillips Petroleum Corp., Bartlesville, Okla., has contracted with government for construction and operation of new plant for production of toluene, an ingredient of synthetic rubber. It will comprise large group of one and multi-story processing and production units, with machinery and electrical equipment. Also power house, power substation, machine shop and miscellaneous structures. Cost about $6,000,000, with financing by Defense Plant Corporation. Project will be carried out by Bechtel-McCone Corp., 601 West 5th St., Los Angeles, Calif., with work scheduled to begin at early date.

FLORIDA—Bureau of Aeronautics, Navy Department, Washington, D. C., plans replacement of underground cable installation for lighting system at naval air station, to cost about $86,000. Appropriation is being arranged. Project will be carried out under direction of Bureau of Yards and Docks, Navy Department, Washington.

KANSAS—Kansas Power & Light Co., Topeka, has approved plans for addition to steam-electric generating station, with installation of equipment for increased capacity. Cost estimated about $500,000. Project is understood to have a priority rating and work will be placed under way at early date. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

OHIO—Jack & Heintz, Inc., 17600 Broadway, Bedford, Cleveland, manufacturer of aircraft starters, has acquired former Ever-Ready battery works of National Carbon Co., comprising several buildings, and will modernize and equip for proposed plant expansion, with installation of machinery and electrical equipment for large output. An existing power plant will be remodeled and improved, with installation of two new 600-hp. boilers and auxiliary apparatus. Cost about $1,200,000, with financing by Defense Plant Corporation. Work will be-



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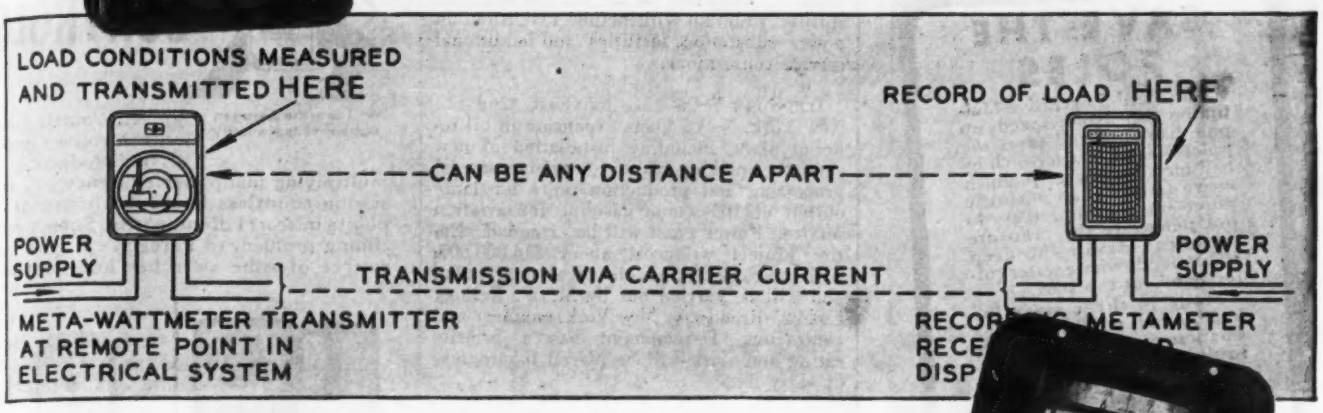
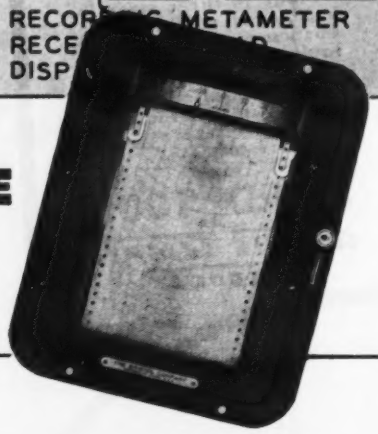

LOAD CONDITIONS MEASURED AND TRANSMITTED HERE
RECORD OF LOAD HERE
CAN BE ANY DISTANCE APART
POWER SUPPLY
TRANSMISSION VIA CARRIER CURRENT
POWER SUPPLY
META-WATTMETER TRANSMITTER AT REMOTE POINT IN ELECTRICAL SYSTEM
METAMETER

ACCURATELY RECORDED HERE

Volts, Amperes, Kilowatts, Kilovolt-Amperes, Reactive KVA, Water Level, Gate Position . . . Reported Over Any Distance



Quick analysis of conditions miles away . . . permitting the system operator to act promptly and properly in cases of emergency and to anticipate and prevent abnormalities . . . is made possible by Bristol's Metameter System of Telemetering.

The Metameter operates on the impulse-duration principle, so is well suited for operation over channels commonly available on power systems, including carrier current of either unmodulated or modulated types. A carrier channel, only two metallic wires, or a circuit selected by supervising control can be used to interconnect transmitter and receiver.

Bristol's Metameter for telemetering electrical quantities is described further in Bulletin M1702. Address THE BRISTOL COMPANY, 116 Bristol Road, Waterbury 91, Conn. (The Bristol Co. of Canada, Ltd., Toronto, Ont. Bristol's Instrument Co., Ltd., London N. W. 10, England).

Among uses of the Metameter are:

FOR LOAD DISPATCHER OF CENTRAL STATION SYSTEM

1. Load (active and reactive power and power demand) in each tie-line interconnecting system with neighboring system
2. Output, or total generated power, of each generating station
3. Total output of all generating stations, on a single instrument
4. Active and reactive power and power demand at key points on important transmission circuits
5. Water level and waterwheel gate position in hydro-electric plant

FOR OPERATOR OF GENERATING STATION

1. Total output generated in system
2. Output of each associated attended or unattended generating station in system
3. Desired output of operator's own station

FOR DISPATCHER OF DISTRIBUTION SYSTEM

1. Total kilowatt load on unattended substations
2. Bus voltage at unattended station
3. Feeder amperes

keeps you a jump ahead of demand

AUTOMATIC CONTROLLING AND RECORDING INSTRUMENTS

SAVE THE POLES

● The Sturd-E exclusive Multipoint Cant Hook speeds up pole handling and saves the poles—its six quarter-inch by half-inch points grip much more firmly than a single point—in addition, they do not penetrate the creosote treatment. Result—no deep stab wounds where water collects and rot can start.

Made in three sizes for handling all poles—from the smallest to the big ones 22 inches in diameter. Every utility that has tested the Multipoint Cant Hook has reordered in ever increasing numbers—it saves poles, time, and cost.

STURD E TOOLS
a TRUE TEMPER PRODUCT

MULTIPOINT CANT HOOK

6 points, ¼" x ½" in size grip the pole securely but leave no deep hole to encourage rot and decay. Points renewable when worn. Furnished in small, medium and large sizes for handling poles up to 22" in diameter. Prices and complete description on request.

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Executive Offices
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Branches and Warehouses with Complete Stocks in Principal Cities of the United States

gin soon. Wilbur Watson & Associates, 4614 Prospect Ave., Cleveland, are architects and engineers.

MINNESOTA—Northern States Power Co., Minneapolis, plans improvements in power plant, including new gate house and other work. Program is scheduled to be carried out at once.

UTAH—Utah Power & Light Co., Salt Lake City, has plans for extensions in primary and secondary lines in north-central part of state for expansion in rural electric system, totaling about 55 miles, in all. A priority rating has been secured and work is scheduled to be carried out this spring. Program will include extensions in power substation facilities and additional service connections.

ILLINOIS—Texas Co., 135 East 42nd St., New York, N. Y., plans expansion in oil refining plant, including installation of new catalytic cracking plant, comprising several processing and production units for large output of 100-octane gasoline for aviation service. Power plant will be extended. Entire project will cost about $14,000,000, with machinery and electrical equipment, and will be carried out by M. W. Kellogg Co., 225 Broadway, New York, engineer and contractor. Development has a priority rating and work will be placed in progress at early date.

NEW YORK—Staten Island Edison Co., Richmond, S. I., has plans under way for new power substation to be equipped for large capacity. Project will include extensions in transmission and distribution lines, and is reported to cost in excess of $3,000,000. It is understood that this will be a post-war development.

MASSACHUSETTS—Bureau of Yards and Docks, Navy Department, Washington, D. C., plans extensions and improvements in navy yard, Boston, for increased facilities for ship repairs, including shops and other structures. Cost estimated about $1,000,000, with mechanical and electrical equipment. Also will install new electric-operated drydock cranes to replace present units, with cost reported about $600,000. A new laboratory building will be erected at cost of about $380,000. This is part of yard development program to be carried out during next fiscal year dating from July 1, and for which appropriations are now being arranged.

IOWA—Municipal Electric Department, Hawarden, will receive bids until April 24 for expansion and improvements in municipal power plant, including installation of new diesel-engine-driven generating unit and auxiliary equipment. Cost estimated about $100,000. Buell & Winter Engineering Co., Insurance Exchange Bldg., Sioux City, is consulting engineer.

WISCONSIN—Water Department, Wauwatosa, is asking bids, to close on or about May 7, for motor-driven deep-well pumping unit and accessories, for installation in pumping station on Blachard St. M. F. Linnan is city engineer.

IOWA—Ordnance Steel Foundry Co., Bettendorf, has plans for new additions to plant for considerable increased output, including several one-story buildings, for which superstructure will begin soon. Installation will include electric furnaces and other electrical equipment. Entire project will cost approximately $600,000. Priority rating has been secured.

Mr. Tops, the Paragon symbol of top quality

Automatic time controls are speeding production . . . multiplying manpower efficiency . . . and saving countless hours in thousands of plants in scores of industries. Submit your timing problem to Paragon . . . your top source of time switches and controls.

ONLY $13.00 LIST — 300 Series self-lubricating time switches are accurate and durable for controlling stokers, oil burners, blowers, pumps, valves, air conditioning, etc. America's leading time switch value.

TIME DELAY RELAYS — The time cycle of Paragon synchronous motor operated, instantaneous reset type relays is unaffected by vibration or changes in ambient temperature. For motor and tube protection.

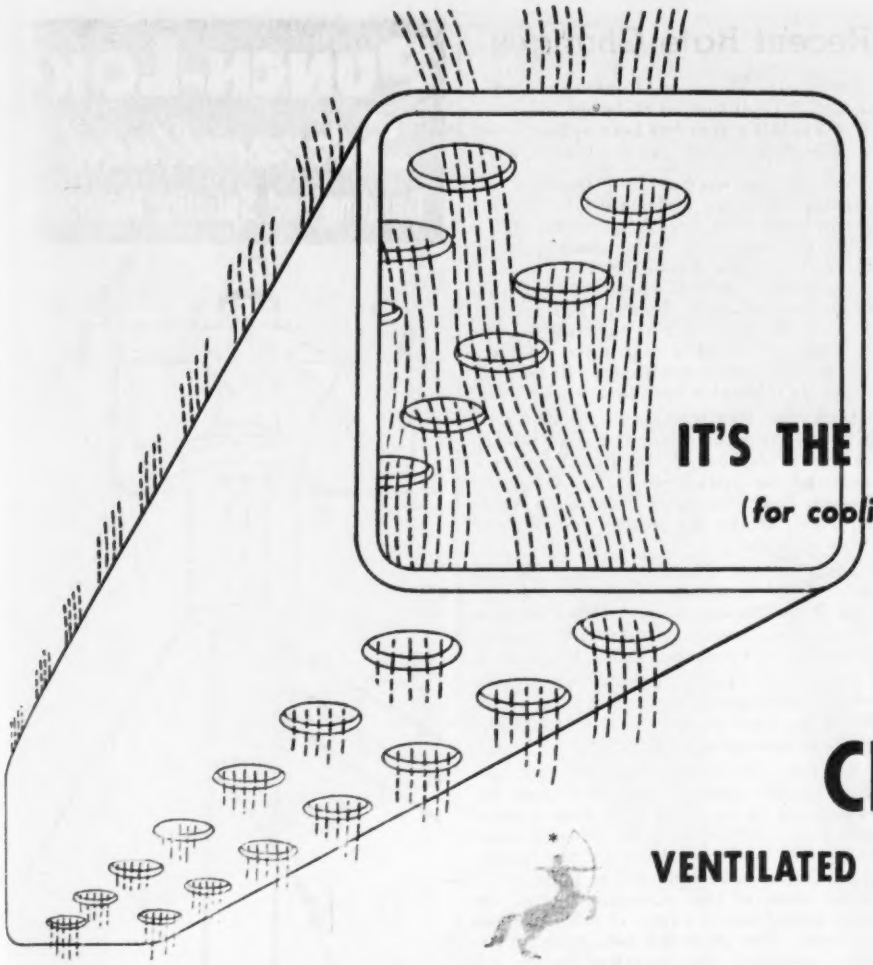
7-DAY TIME SWITCHES — . . . are designed for presetting heating or ventilating schedules on a weekly basis with independent daily operations.

MANUALLY PRESET TIMERS — The 2500 series is designed to close or open a circuit at the end of a preset interval, such as attic fan control.

All these units are designed and built by Paragon . . . a pioneer in the automatic timing field. Send for complete bulletin.

PARAGON ELECTRIC COMPANY
703 OLD COLONY BUILDING
CHICAGO 5, ILLINOIS

Paragon Chicago
BUILDERS OF ELECTRICAL EQUIPMENT



IT'S THE VENTILATING HOLES

(for cooling by natural convection)

IN

CHASE*

VENTILATED BUS CONDUCTORS

that increase current carrying capacity AND help conserve critical copper

For AC bus installations, the advantages of square copper tube are many. Noteworthy are heavy one-piece construction, high current carrying capacity and maximum mechanical strength in all directions.

To these, Chase engineers have added another—ventilating holes, for internal cooling by natural convection. This, of course, increases current carrying capacity of the bus conductor . . . but more than that, ventilating holes help conserve critical copper.

Consider all these service-features of Chase Ventilated Square Tube before you decide upon any new AC bus installations. The Chase Electrical Handbook contains complete information on this and other conductor forms. For a complimentary copy, write to Dept. **EW-4.**

TO SAVE YOU TIME ON BUS CONDUCTOR CALCULATIONS

Chase engineers may be able to save you hours of work on electrical problems . . . help you in calculating the most economical size and shape of bus conductors for your conditions. Simply outline your requirements.

*Reg. U. S. Pat. Off.

CHASE BRASS & COPPER CO.

—Incorporated—

Waterbury 91, Connecticut

SUBSIDIARY OF KENNECOTT COPPER CORPORATION

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MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON†

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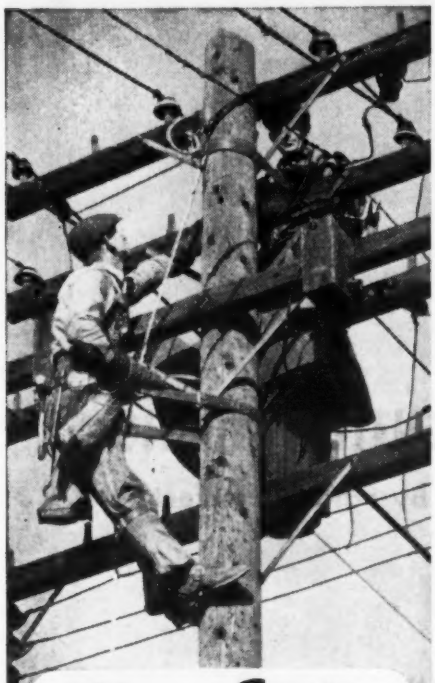
This is the Chase Network—handiest way to buy brass



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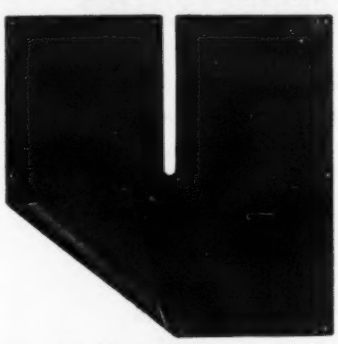
TURN-CUFFS

Their dependability a matter of record . . . their popularity based on performance. Cuffs up form a petticoat insulator effect — minimizes surface creepage. Turned down, a 2-inch longer protective gauntlet. Yes—MORE COMFORT, MORE SAFETY.

SLOT-TO-CENTER BLANKETS



45" x 45". More practical for covering spool and secondary wires, switches, dead ends, transformers. For primary or secondary lines.

NON-BINDING SLEEVES

Tough, high voltage stock gives maximum protection and long field service. No bulk in front — adjustable. Cost no more than usual types. Write for complete information.

THE *Surety* RUBBER COMPANY
Carrollton, Ohio

Recent Rate Changes

WISCONSIN MICHIGAN POWER Co's rate cut for 3,287 commercial customers, amounting to $13,200 a year has been approved by the Wisconsin Public Service Commission.

BUFFALO NIAGARA ELECTRIC CORP. and the Niagara, Lockport & Ontario Power Co. have reduced their residential electric rates $1,045,000, according to an announcement by the New York Public Service Commission. The new rates affecting consumers in the western section of the state, will become effective on April 15. A reduction of approximately $500,000 a year in the commercial rates of the two companies will be filed as soon as schedules have been worked out.

ARKANSAS PUBLIC SERVICE COMMISSION has taken under advisement after an all-day hearing a petition of the Eighth Service Command for reduction of the Arkansas-Missouri Power Co. rates charged the Army and Navy at the Blytheville and Walnut Ridge airfields.

NOVA SCOTIA PUBLIC UTILITIES BOARD has ordered new rate schedules for the Avon River Power Co. and Milton Hydro-Electric Co., involving reductions totaling $150,000 for Avon and $3,500 for Milton.

WISCONSIN PUBLIC SERVICE COMMISSION recently announced that in 1944 public utilities in the state decreased rates $1,002,292. Increases amounted to $16,712.

WESTERN MASSACHUSETTS ELECTRIC CO. (Springfield) plans future rural line extensions up to one-third mile from present lines to any farmer agreeing to use a minimum of $2 worth of electricity per month. Lines several miles long will be built in unserved areas at this minimum rate if the farms served are in a ratio of three or more per mile. The proposed new minimum is about one-third that required before the present war. The program hinges upon release of materials by WPB. The company has filed a new street lighting schedule for Springfield saving about $4,000 per year over the former contract, the rates ranging from $100 per 15,000-lumen lamp per year to $23 for 1,000-lumen lamps.

•

Recent Legislation

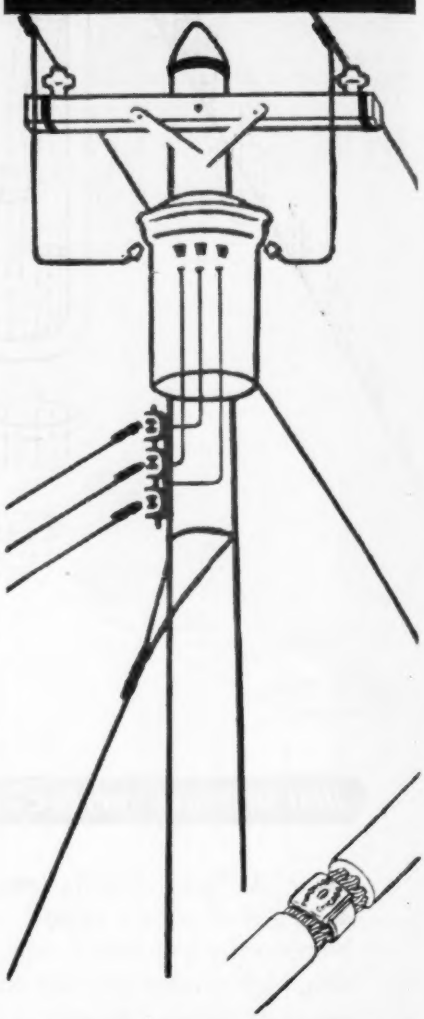
COLORADO—Under the terms of a measure introduced in both House and Senate, the State Tax Commission shall assess REA properties on a basis of one-half their annual gross revenue. A public hearing in the House, preliminary to introduction of the bill, developed testimony that REA units now pay about 50 percent less taxes than private utilities, and that a further reduction would impose an undue burden on taxpayers who would derive no benefit from the cooperative enterprises.

INDIANA—Governor Ralph F. Gates has signed a bill passed by the Legislature, which amends the municipal corporation act to permit second-class cities operating two or more utilities to create a municipal employees' pension fund. Electric and gas utilities are chiefly concerned.

MAINE—Governor Horace A. Hildreth has signed a bill, creating the Passamaquoddy District Authority empowered to construct and operate power plants at Eastport, scene several years ago of a Federal tide-harnessing project which was suspended. (ELECTRICAL WORLD, March 3, 1945, page 158).

NEBRASKA—Governor Griswold has signed LB43, providing for sale by a public power district of a transmission line extending into

PUNCH-LOK
Streamlined
Banding and Splicing Method



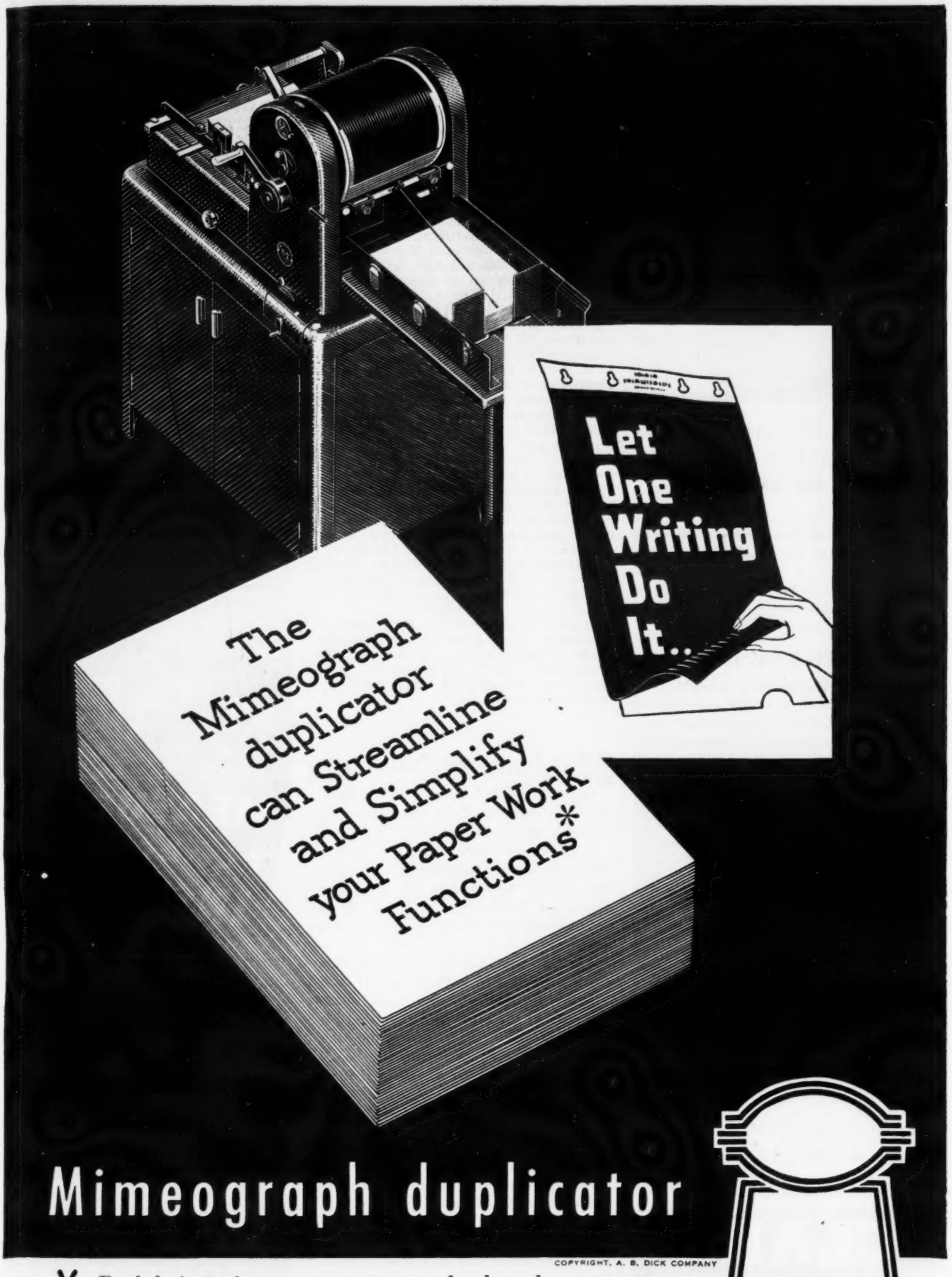
With Punch-Lok Clamps, applied with the Loking Tool, you can make connections easily, quickly, simply, safely...without taking down wires or installations. Will withstand any normal pull strain. Many other applications for repairing, banding, splicing, tying.

Write for descriptive catalog and name of nearest distributor

Keep Buying War Bonds

PUNCH-LOK COMPANY

Dept. R, 321 N. Justine Street
Chicago 7, Illinois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The Mimeograph duplicator can Streamline and Simplify your Paper Work Functions*
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CLARK'S WIDE-AREA, LOW-TEMPERATURE HEATING PRINCIPLE HAS STOOD THE TEST OF TIME AND TOUGH SERVICE

Typical of the many old Clark Electric Water Heaters still in daily service is the one above in the home of G. E. Aldrich in Fillmore, N. Y. Says Mr. Aldrich, "This heater has been in constant use for better than 18 years, and the upkeep has been practically nothing."

GENTLE HEAT MEANS LONG LIFE

The secret of Clark's long, trouble-free service is "gentle heat"—heat applied in a broad band at a temperature only slightly higher than that desired in the water. This wide-area, low-temperature method of heat application, pioneered by Clark, eliminates destructive liming, corrosion and oxidation—proved by long service in areas where other types of heaters have failed in only a few months.

★

A CLARK FRANCHISE FOR YOUR TERRITORY MAY STILL BE OPEN. WRITE FOR FULL DETAILS.

McGRAW ELECTRIC COMPANY
CLARK WATER HEATER DIVISION
5201 West 65th Street, Chicago 38

CLARK
ELECTRIC WATER HEATERS
A Toastmaster Product

another district, and LB44, providing for the auditing of public power districts subject to examination by the Rural Electrification Administration and providing that the state auditor may accept an audit made by a Federal auditor.

CANADA—Broader authority is stipulated for the Nova Scotia Power Commission in a bill before the provincial assembly. Authorization is sought for the commission to start construction of any electrical extension to rural areas where there are three contracts of domestic classification and four potential domestic customers for every mile. The present rural electrification legislation necessitates three contracts and six potentials per mile. The bill calls for a tax on any firm, corporation or municipality generating or distributing electrical energy. The proposed tax is one-twentieth of a cent per kilowatt-hour for industrial purposes and one-tenth of a cent for domestic or commercial purposes. No public utility will be allowed to proceed with construction of any electric transmission or distribution extension costing more than $1,000 without notifying the commission of its intention.

Regardless of the provisions of any franchise agreement, the Local Government Board may cancel or vary any agreement for the supply of water, gas or electric energy or the operation of any street railway or bus system in any city, town or village of Saskatchewan, according to the provisions of an amendment to the Public Utilities Companies Act passed by the Legislature. The agreement may be cancelled or altered by the board if the franchise holder is not proceeding with "reasonable promptness" or completeness to provide the services contemplated by the franchise agreement; if the service being given by the franchise holder is inefficient or fails to meet the "reasonable needs" of the public, or if it is for any reason "expedient" in the public interest to do so.

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OWU Approves Turbines

Office of War Utilities' Power Division has authorized the installation of two new steam turbines.

A 30,000-kw. turbo-generator and a boiler for it was authorized for installation in the Green Bay plant of the Wisconsin Public Service Corp. It is not expected to be in service before late next year.

The Oklahoma Gas & Electric Co. was given a 10,000-kw. topping turbine and a boiler for its Horseshoe Lake plant. Capacity of the plant will be raised between 22,000 and 23,000-kw. by the combined installation, which is to be in service by the summer or fall of 1946.

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Kentucky Co-op to Expand

Shelby Rural Electric Cooperative of Shelbyville, Ky., has received permission from the Public Service Commission to erect 50 extensions, none more than three miles long, in Carroll, Henry, Shelby, and Trimble Counties. To finance the work, the co-op will apply for a $60,000 loan from the Rural Electrification Administration.

MEASURES AC or DC Current INSTANTLY

Instantaneously, by merely "snapping" the tongs around any electrical circuit, you can measure the current — BOTH A.C. and D.C. up to 800 amperes — without necessitating a break in circuit or insulation. Every electrician should have one. It's a time saver — production speeder. Weighs only 2¾ lbs. and is as simple to use as the illustration above suggests. Write today for our TONG TEST Bulletin describing its many time-saving applications.

COLUMBIA ELECTRIC MFG. CO.
4519 Hamilton Ave., N.E., Cleveland 14, O.

COLUMBIA
TONG TEST AMMETERS

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Everything points in that direction. Since the days of the "pin-point" illumination of the candle the trend has been toward more and more diffusion in artificial light, with softer shadows and less eye fatigue. In this progress Frink Engineering and Frink Lighting Fixtures, the result of years of research in the science of illumination, have played a prominent part.

Modern fluorescent lighting, though still restricted by military requirements, has grown familiar to millions who, during the war years, have worked in war plants and essential businesses. Whether in an office, at a work bench or at a machine, fluorescent lighting has proved itself impressively better.

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THE ULTIMATE IN FLUORESCENT LIGHTING

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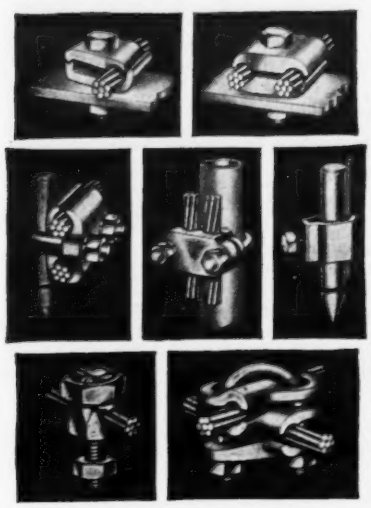

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Conductor Fittings

REA Allots Funds; Approves Contracts

Allotments totaling $758,000, to be used mainly for the extension of electric service to farms located near existing lines, were recently approved by the Rural Electrification Administration. These allotments bring the total to $522,911,351, of which $24,031,550 represents operations during the current fiscal year. No construction will be undertaken which does not have WPB approval.

Allotments include the following:

INDIANA—Carroll County Rural Electric Membership Corp., Delphi, $58,000.

IOWA—Nyman Electric Cooperative, Inc., Stanton, $15,000.

MISSOURI—Intercounty Electric Cooperative Assn., Licking, $20,000; Tri-County Electric Cooperative Assn., Lancaster, $25,000.

OKLAHOMA—Kay Electric Cooperative, Blackwell, $15,000; Oklahoma Electric Cooperative, Norman, $20,000; Canadian Valley Electric Cooperative, Inc., Seminole, $15,000.

TENNESSEE—Tri-County Electric Membership Corp., Lafayette, $300,000; Fort Loudoun Electric Cooperative, Madisonville, $50,000.

TEXAS—Wood County Electric Cooperative, Inc., Quitman, $25,000; Grayson-Collin Electric Cooperative, Inc., Van Alstyne, $20,000; Denton County Electric Cooperative, Inc., Denton, $13,000.

VIRGINIA—Powell Valley Electric Cooperative, Jonesville, $127,000; Tri-County Electric Cooperative, Leesburg, $30,000.

WEST VIRGINIA—Harrison Rural Electric Assn., Inc., Clarksburg, $25,000.

Construction Contracts Approved

ARKANSAS—Ouachita Rural Electric Cooperative Corp., Camden, contract to Harvill and Byrd Electric Co., Little Rock, Ark., 3 miles of line and conversion of 16 miles of line from one to two phase; $12,553; engineer, Southwest Electrical Engineers, Jonesboro, Ark.

ILLINOIS—Rural Electric Convenience Cooperative Co., Divernon, contract to L. E. Myers Co., Springfield, Ill., 11.2 miles of line; labor only, $4,387.

KANSAS—Cooperative Power & Light Co., Inc., Iola, contract to A. F. Reis, Topeka, Kansas, 152.9 miles of line; labor and materials, $157,405; engineer, Flora Engineering Co., Cheyenne, Wyo. P. R. & W. Electric Cooperative Assn., Inc., Wamego, contract to J. R. Foree Contracting Co., Topeka, Kansas, 27 miles of line; labor and materials, $24,801; engineer, Frank Horton & Co., Lamar, Mo.

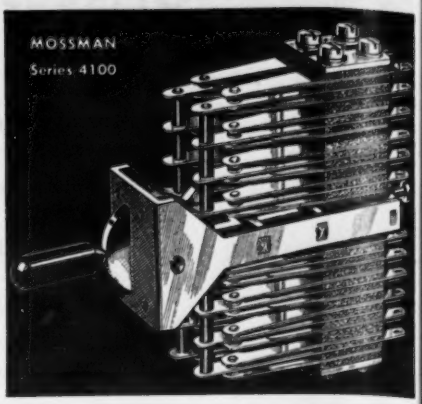
LOUISIANA—Beauregard Electric Cooperative, Inc., DeRidder, contract to Delta Construction Co., Clarksville, Miss., 83 miles of line; labor and materials, $51,561; engineer, Swanson-McGraw-Hooper, New Orleans, La.

•

Hawaiian Utility To Expand

Hawaiian Electric Co. has been authorized to enlarge its generating facilities at Pearl Harbor in legislation which has been signed by President Roosevelt.

MOSSMAN
SERIES 4100
Lever Switch



Provides the Most Versatile Contact Arrangements

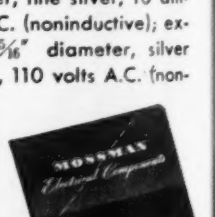
The Mossman Series 4100 Heavy Duty, Lever Switch is especially adapted to electrical or electronic control circuits where it is necessary to switch a control to a master control section. The number and type of interlocking circuits possible with this switch are entirely at the discretion of the circuit designer.

Interlocking contact arrangements which may be added or provided by the use of this versatile switch would be impractical with any other type of switch or plug-in system.

The Series 4100 is a three-position switch with locking action in center or neutral position, locking or nonlocking in other two positions as required. Use of a special latch plate eliminates the neutral position and converts it into a two-position switch.

Contact ratings are: Standard heavy duty—3/16" diameter, fine silver, 10 amperes, 110 volts A.C. (noninductive); extra heavy duty—5/16" diameter, silver alloy, 20 amperes, 110 volts A.C. (noninductive).

SEND FOR THE MOSSMAN CATALOG
It contains complete details of the many precision electrical components which make up the Mossman line.



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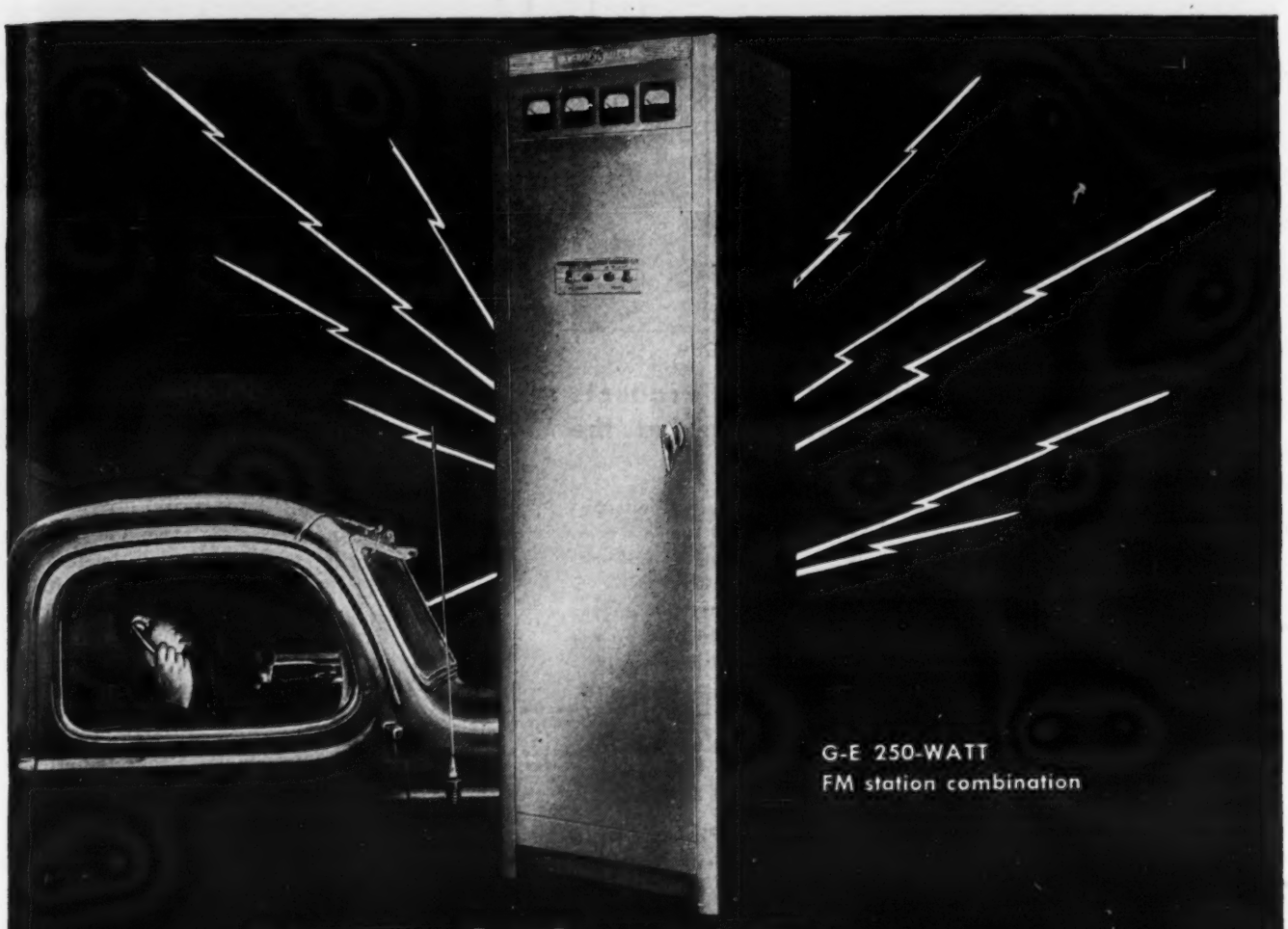
MOSSMAN
Electrical Components



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FOR RADIO SUPERVISION OF SYSTEM MAINTENANCE

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• For additional information on the G-E 250-watt FM station combination, and on General Electric's complete line of 2-way FM communication equipment, call your G-E sales engineer. *Electronics Department, General Electric, Schenectady 5, N. Y.*

Government regulations now permit new installations of 2-way FM radio for important requirements of utility companies. Your G-E representative will help prepare your application.

Hear the G-E radio programs: *"The World Today" news, Monday through Friday 6:45 p. m., EWT, CBS. "The G-E All-Girl Orchestra," Sunday 10 p. m., EWT, NBC. "The G-E House Party," Monday through Friday, 4 p. m., EWT, CBS.*

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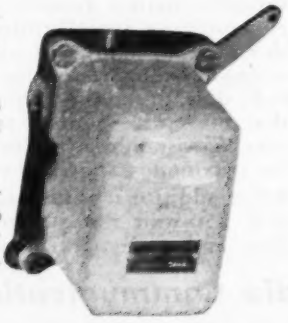

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LETTERS TO THE EDITOR

Structures Indeterminate

To the Editor of ELECTRICAL WORLD:

Mr. Carl G. Erickson has done a fine job of further simplifying the design of pole line structures, particularly the H-frame with cross brace. However, in my opinion, the design is not as simple as he has tried to make it. He has stuck strictly to statics, although the cross braced structure is statically indeterminate.

I take specific exception with his fourth article appearing in the issue of September 16, 1944, on page 108.

In the first place the plane of contraflexure cannot be located by the use of similar triangles constructed with values taken from the resisting moment diagram of the poles.

Furthermore, Mr. Erickson has neglected to indicate how the strength of the structure depends upon the location of the brace, and how it should be located to provide the greatest strength. This is important because the maximum strength of the structure should be realized. Too often the brace is arbitrarily located, as Mr. Erickson has evidently done.

I made a study some time ago, but which I never published, of the subject in question. It affords adequate proof of my contention.

Leonard V. Smoot
60 Rossford Ave.
Ft. Thomas, Ky.

Author's Response

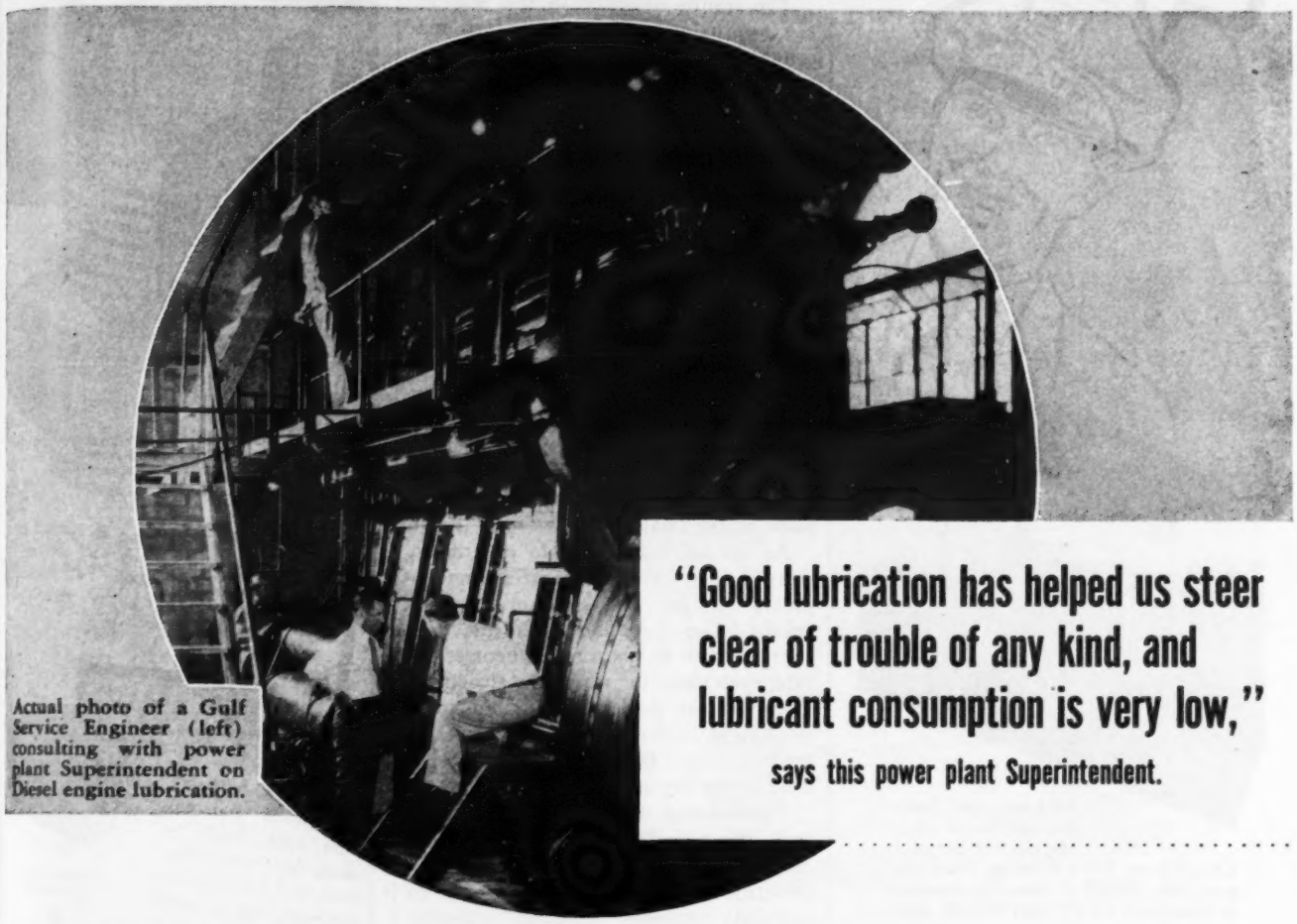
To the Editor of ELECTRICAL WORLD:

I have read with interest Mr. Smoot's comments on Part IV of the article entitled "Stress Calculations for Pole Line Structures."

It seems to me that Mr. Smoot failed to observe that my article did not deal with pole line design but rather that which the title indicates. Mr. Smoot is right in saying that the H-frame is a statically indeterminate structure. But it is not unusual practice in structural design to make assumptions in problems of this kind, and then treat the structures as if they were statically determinate. This is done to allow for some of the unknowns and to permit the use of simpler calculations than would have to be used otherwise. Therefore, the results of such calculations are approximate only.

The method outlined in my article is based on the assumptions that the poles of the H-frame are fixed at the base and at the cross braces, that the ex-

Another Diesel makes a fine operating record with GULF PARVIS OIL!



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"Good lubrication has helped us steer clear of trouble of any kind, and lubricant consumption is very low,"

says this power plant Superintendent.

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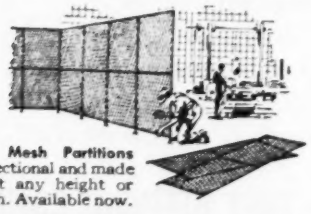

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ternal forces are transferred to the ground reactions over paths of equal rigidity, that the material is not stressed beyond the elastic limit, and that the poles at the braces remain in a vertical position.

In the method of similar triangles it is assumed that each of the reversed parts of the pole takes stress at its point of maximum bending according to its resisting moment at that point.

The results obtained in this manner are approximate only. They are reasonably accurate for standard class poles which have comparatively slight taper. If results are compared with the plane of contraflexure located at the position where the total horizontal deflection between the base of the pole and the pole at the bottom of the cross brace is least it will be found that the latter location is slightly below that found by the method of similar triangles. The actual location of the plane is probably somewhere between these two locations.

For poles with a sharper taper than standard class poles, it is important to locate the plane of contraflexure at the position of least deflection. In order to avoid complex calculations, this can be done by the trial method.

As far as I am able to determine, there is not much agreement among engineers as to the assumptions that should be used in finding the plane of contraflexure on the braced bent structure, even those for which the structural materials are manufactured under the most rigid controls. I do not expect to settle it here. But whatever method is used, some assumptions must be made.

The natural wood pole is a logical and economical item in transmission line construction. For a single pole structure it is comparatively easy to calculate stresses because, substantially, bending only is involved. But an H-frame is a high, narrow structure where the direct stresses are likely to be considerable. Also each pole in the structure is certain to vary in more or less degree from the other one. In the theoretical pole there is an allowable sweep. Any exact calculation for stresses in an H-frame, even for a theoretical one, should take into account all of these. Also assumptions must be made with regard to the type of joints at the braces and the rigidity of the poles at the ground line.

The method used in my article takes into account the direct stress, and suggests that it be used in finding increased bending moments in certain cases. It should be noted here that the location of the plane of contraflexure is not an end in itself but is used only for calculating stresses in the braces and in the pole below the braces.

I think that too much emphasis

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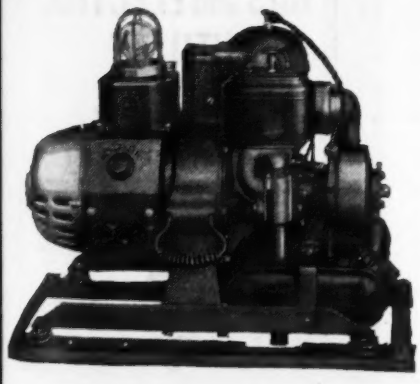

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should not be placed on full scale H-frame tests as the basis for pole line design. I realize that results of tests of this kind can be carelessly interpreted; also that such tests can seldom exactly represent conditions as met with in the field. However, it might be interesting to mention a test made on a full scale H-frame in 1943. In this test a reasonable effort was made in matching the two poles. On account of the direct stress, the bending moment of the pole at the bottom of the brace was increased by 2,000 foot pounds. At the time the poles were under bending stress at a safety factor of 4.5. If the safety factor had been reduced to, say, 3.0, the bending moment would have increased appreciably. It would have increased still more if the pole had the allowable sweep below the bottom of the brace. A dynamometer in the tension brace checked reasonably close with calculations for tensile stress in the brace and for the location of the plane of contraflexure by methods outlined in my article. Tests on various small scale models likewise prove that method of calculation reasonably satisfactory.

I believe that, in view of the complexity of the H-frame, the engineer may make rather wide assumptions in the calculations for the plane of contraflexure. Perhaps all of this should have been fully explained in my article, although I had meant the second paragraph of my paper to take care of it.

But by whatever basis for design, the engineer should realize that the H-frame is a structure with many unknowns as compared to a single pole, therefore, it should be designed with a slightly higher safety factor than has been found satisfactory for the single pole. Where the soil is loose and if no means are taken to secure a firm foundation, the structure may approach the condition of being hinged at the ground line and the use of cross braces should not be given serious consideration.

C. G. Erickson
Northern Indiana Public Service
Hammond, Ind.

Refrigerator Meditations

To the Editor of ELECTRICAL WORLD

In your January 6th issue you printed a letter signed by one George Kerr in which he states that it was demonstrated at the time of the hurricane last fall that the electric refrigerator is the most indispensible appliance in the home; and goes on to deplore the fact that friends of Mrs. Kerr and himself did not know that their refrigerators are operated by electricity and hence no current no ice.

Now I took the matter up with that best (to me) of all authorities my wife, and she said: "I agree with Mr. Kerr

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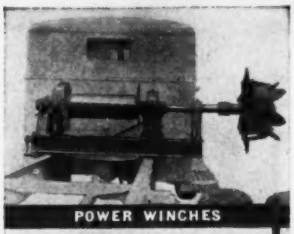

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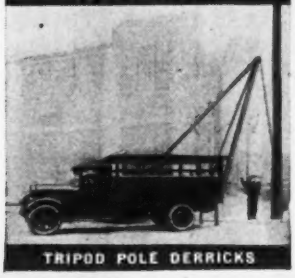

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Keeps parts in easy reach and speeds up the job.

For line work it is worn attached to the body belt; general operations over the trouser belt.

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INDUSTRIAL PRODUCTS COMPANY
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that their friends Vera and Ethel are dumb. Don't those gals ever defrost their refrigerators? And when they do, don't they know they are cutting off the electric current. If they do not, then they *are* dumb and how! Unless, on second thought. they have gas operated refrigerators and there are a lot of those, in case Mr. Kerr would like to know."

She went on to say—"I don't see any difference in these women, whose efficient refrigerators and constant electric current encourage and foster lack of familiarity with their operation, from the automobile owner who tinkers with everything under the hood of his car when the reason it won't start is an empty gasoline tank."

Mr. Kerr complains but he fails to offer any plan for continually reminding the housewife and her lesser half of the source of their main blessings, to wit—the electric wire. We have had "the abused husband", "the neglected wife", "the unwanted child" in our scheme of things, but now Mr. Kerr has to complicate matters by adding "the forgotten kilowatt." So, after much research and thought and consultation I suggest several excellent plans to remedy the situation complained of by Mr. Kerr, and offer the same humbly and without expectation of recompense.

1—Have a representative of the electric company call up each customer weekly to ask softly "Does your icebox smell differently lately?"

2—Arrange to have hurricanes more frequently.

3—Put a small phonograph inside the refrigerator which, when the door is opened will automatically play a record saying, confidingly, "I am Reddy Kilowatt! I run your icebox! You can't see me, but I'm always here, dearie."

Gee whiz, do you suppose that Vera and Ethel and that chemist friend of Mr. Kerr's, not knowing that electricity lurks in their iceboxes, try to blow the interior light out every time they close the door?

Cato (who else?)

AVOID CABLE ABRASION *with*
STAPUT FAIRLEADERS

"Rubbing at the duct mouth can be reduced by installing fairleaders on the cables at this point."—from Electrical World, May 29, 1943 (Cables—How to Make Them Last).

These non-corrosive alloy cable shields clamp in place to take wear at duct mouth. Easily and safely installed without interruption of service. Eliminate expensive repairs. Use STAPUT FAIRLEADERS. *Write for free catalog.*

Wm. B. Berry Co., 88 North St., Boston, Mass.

EVERSTICK ANCHORS...

FOR SPEED IN INSTALLATION

The exclusive Everstick nut housing locks the Anchor firmly on the rod. This speeds up installation. Plates are so designed, that they expand easily into undisturbed earth, and extra holding power is achieved. Made of tough, rust-resistant malleable iron. Write for bulletin.

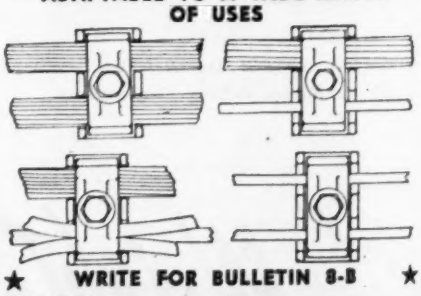
EVERSTICK ANCHOR CO.
FAIRFIELD, IOWA

A Live Wire is no better than its Connections

UNIVERSAL Tap Connector

Effectively used as guy line ground, or transformer and lightning arrester connection to A. C. S. R. or copperweld conductors where the diameters may be from 8-A copperweld to .595" A. C. S. R. armour rods. Wire sizes .595" to 5/32".

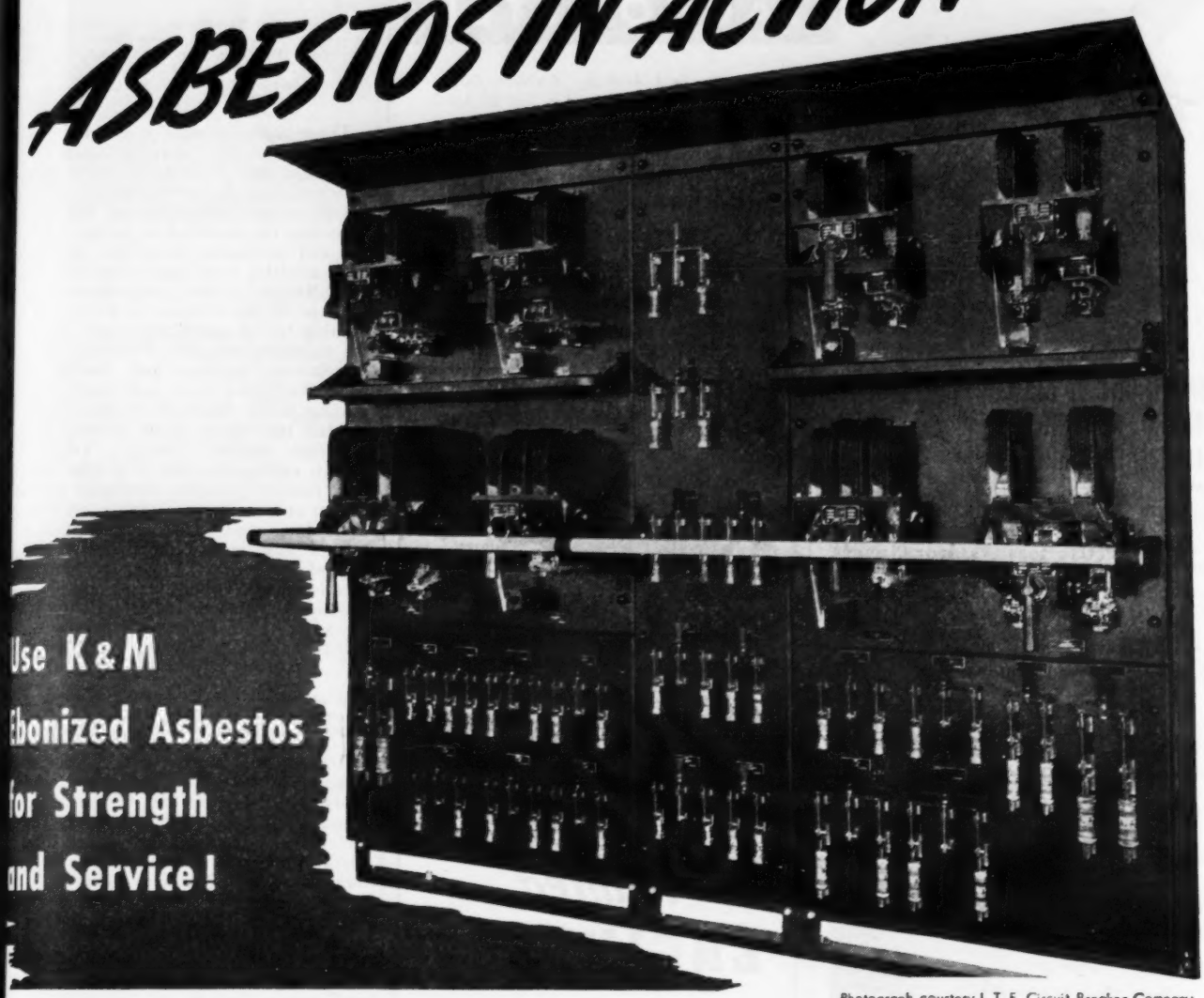
ADAPTABLE TO A WIDE RANGE OF USES



★ WRITE FOR BULLETIN 8-B ★

K&H KRUEGER & HUDEPOHL
Solderless Terminal Lugs and Connectors
SE VINE AT THIRD • CINCINNATI 2, OHIO

ASBESTOS IN ACTION



Photograph courtesy I. T. E. Circuit Breaker Company

Asbestos fibre, binding cement and insulating compound are combined by K&M to make this mounting material *extra durable.*

K&M Ebonized Asbestos comes in sturdy, monolithic sheets. Here are its special features . . .

- **Exceptionally high dielectric strength**
- **Uniform density throughout**
- **Withstands severe shock, vibration and wide temperature variations**
- **Resists oil and water action**
- **Does not shrink, crack or bulge**

Manufacturers of completely assembled units find that Ebonized Asbestos gives excellent service. Fabricating companies who cut and drill the material say it is tops for bus bar runs, testing tables, panel boards and other uses where electrical resistance is required.

Thanks to expanded facilities, K&M Ebonized Asbestos is available for prompt delivery. Comes in thicknesses from 1/8" to 4", standard or special "panel" finish. Specially developed to meet technical requirements of the Underwriters Laboratories, Inc., when built into an assembled unit.

ARMY E NAVY
K&M best in asbestos

Nature Made Asbestos

Keasbey & Mattison have been making it serve mankind since 1873.

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

NEW MODEL • HIGHEST ACCURACY
CHRONOMETRIC
TACHOMETER

Readability to 1 RPM per division. Guaranteed accuracy well within ½ of 1%. Indicates RPM directly on the dial without any calculations over a fixed period of 6 seconds. Negligible torque. Two models with ranges 0-1000 RPM or 0-10,000 RPM, each suitable for double rated range.

Write for bulletin No. 715.

HERMAN H. STICHT CO., INC.
27 PARK PLACE NEW YORK, N. Y.

BURNED-OUT or BROKEN
ELECTRIC HEATING
ELEMENTS REPAIRED

New Amazing Nichrocite Paste repairs heating elements in electric toasters, irons, ovens, furnaces, etc., quickly and thoroughly. Simply overlap ends, apply Nichrocite Paste and turn on current. A perfect, long-lasting, money-saving job in a jiffy! Used successfully by large utility companies and others. Generous trial offer, $1; 4 oz., $2.50; 1 lb., $8.00. Satisfaction guaranteed.

ADVANCE MFG. CO., Box 861-H Minneapolis, Minn.

NEW

WRITE
FOR CATALOG
164

QUICK-START
FLUORESCENT LAMP BALLAST
THE ACME ELECTRIC & MFG. CO.
Cuba, N. Y. Clyde, N. Y.

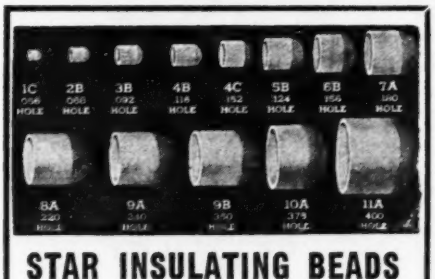
Acme ACME Electric
TRANSFORMERS

PREMAX

FOR LASTING
IDENTIFICATION

Before you renew your pole markings, investigate Premax Metal Markers. Cheaper than stenciling and will outlast the pole.

Premax Products
Division Chisholm-Ryder Co., Inc.
4518 Highland Ave., Niagara Falls, N. Y.



STAR INSULATING BEADS

Use LAVOLAIN ball and socket beads for insulating bare wire. Heat resistant. High di-electric and mechanical strength. Made in U.S.A. Quality beads at low cost. Quickly applied. Flexible. Beads shown above are approximately half actual size. Ask for price list and samples.

STAR PORCELAIN CO.
51 Muirhead Ave. Trenton, N. J.

Wanted
ENGINEERS

Radio
*Electrical
Electronic
*Mechanical
*Factory Planning
Materials Handling
Manufacturing Planning

Work in connection with the manufacture of a wide variety of new and advanced types of communications equipment and special electronic products.

Apply (or write), giving full qualifications, to:

R.L.D., EMPLOYMENT DEPT.

Western Electric Co.
100 CENTRAL AV., KEARNY, N. J.

*Also: C.A.L.
Locust St., Haverhill, Mass.

Applicants must comply with WMC regulations

BOOK REVIEWS

Engineering for Dams: Vol. I, General Design (24 pages, $4.50); Vol. II, Concrete Dams (618 pages, $6); Vol. III, Earth Rock-Fill, Steel and Timber Dams (929 pages, $6). William P. Creager, Joel D. Justin and Julian Hinds. Published by John Wiley & Sons, New York.

These three volumes constitute a working-design treatise drawing upon the attacks and achievements of engineers who have designed the world's dams. The tooling of the art of exploration, analysis and execution are provided in terms of hydraulics and mechanics fourmulas and empirical quantities to a manifestly high degree of authenticity and comprehensiveness.

Scope of the volumes is attested by the ensuing list of significant topics treated in the respective volumes. Volume I: Borings, foundations, seepage and leakage (flow nets), hydraulic jump and erosion control, stilling pools, table of record flood-flows, rainfall, infiltration, runoff, hydrograph construction, spillway design. Volume II: Uplift, earthquake factor, gravity stability (six rules of design), examples of profile design and spillway discharge calculations, arch dams and elastic deformation, buttressed and multiple-arch dams, technology of concrete. Volume III: Soil characteristics, earth dams, cores and hydraulic fills, seepage and drainage, stability, foundation shear, steel dams, timber dams, fish protection, crest control and gates.

Soul of Amber, by Alfred M. Still. Published by Murray Hill Books, Inc., New York, N. Y. 276 pages. Price $2.50.

Too few electrical engineers know much more about the origins of their science than that Volta, Ampere and Conlomb—maybe Oersted and Gauss—played a role. If they're conscious of their narrow outlook, want to know what others contributed they can learn here about 220 such pioneers. At the same time they will sense how tedious and faltering is the birth and youth of a new art while it leans on the alchemists, theologians, physicians, philosophers, astronomers and the indispensable court patronage. This well-known author of "Electric Power Transmission" in this instance has delved in the archives to reconstruct the evolution of electrical understanding in the groping minds of insatiably curious explorers. At the end one wonders whether some of our "explanations" today are much more bullet-proof than the best of the clumsily phrased hypotheses of our technical progenitors.

How to Establish and Maintain Personnel Department. Francis Spodick, research assistant under direction of Leona Powell, director of AMA information and Research Department. Published by American Management Assn., 330 West 42nd St., New York 18, N. Y. 114 pages, illustrated. Price $1.50 to AMA members; $2.25 to others.

Whereas executives previously made cautious inquiries as to what they might gain from a specialized program of personnel activities, they now seek positive assistance on how to get about installing such a program. They want to know what advance preparations are desirable, the correct allocation of responsibility and authority between the staff department and the line organization, and similar details of planning and procedure. In short, the need is no longer so much to "sell" management on the wisdom of a system of sound human relations as it is to provide a constructive and forward-looking guide to action. It is this need that the book attempts in part to fulfill.

For Electrical Installation, Maintenance, Repair— Light anywhere— at the flick of a finger— with

Big Beam
PORTABLE ELECTRIC HAND SEARCHLIGHTS

The men who install, maintain and repair electrical wiring and equipment must work under any and all conditions. Big Beam enables them to put light on the work wherever it may be called for. It projects a beam of more than 2500 feet and by the use of a snap-on lens gives the same volume of light over a wide area. Lights up anything at any height—any recess or corner, at the flick of a finger, and can be set down anywhere—on a bench, shelf or floor —or can be clamped to any flat surface by means of a hold-down. Big Beam is working in war plants and on war fronts, doing the same jobs it can do for you. Put it to work for you. It will be a valuable assistant.

Write today for catalog and full description of Big Beam Portable Electric Hand Searchlights. Storage battery or dry cell models.

U-C [illegible] Mfg. Co.

Dept. D • 11 E. Hubbard St. • Chicago 11, Ill.

Here are some men who can tell you about postwar sleep

YOU SEE, all this time they've been wearing G-E "electrically-warm" flying suits — first cousin to the G-E Blanket (first automatic electric blanket ever made, 55,000 already in use).

Obviously, practical wartime experience —and research—will lead to many new improvements after the war. In this case, to a new kind of sleeping comfort.

The new and better blankets available after the war will open up a big new load-building opportunity. Just *two* automatic blankets are equal in load to a 6 cu. ft. refrigerator. *And blanket load is all off-peak load.*

G. E. is already paving the way for you with an extensive advertising campaign in Life, Good Housekeeping, House Beautiful, This Week, Atlantic Monthly, Harper's Magazine.

For further information, write: General Electric Co., Appliance and Merchandise Dept., Bridgeport, Conn.

TUNE IN: *"The G-E House Party," every afternoon, Monday through Friday, 4 p. m., E.W.T., CBS. "The G-E All-Girl Orchestra," Sunday, 10 p. m., E.W.T., NBC. "The World Today," news, Monday through Friday, 6:45 p. m., E.W.T., CBS.*

FOR VICTORY— BUY AND HOLD WAR BONDS

Great new off-peak load-builders:

Automatic Blankets

GENERAL ELECTRIC

MAYBE IT'S TIME
to get down to earth

Today in many utility lighting departments the postwar sales setup has been organized. Training programs are being worked on and there has already been established the frame-work of experienced manpower.

Yet in their thinking, some of these men may have their heads "in the clouds." In planning for tomorrow's lighting, they may be thinking only in terms of new construction and extensive remodeling

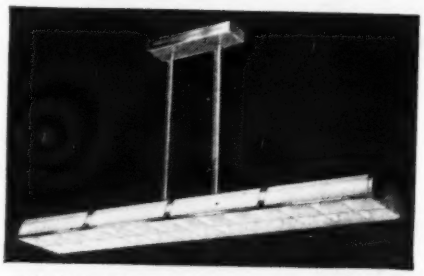
Could it be that *your* lighting people in their thinking are overlooking the opportunities offered by hundreds of offices, plant offices, drafting rooms and smaller stores? These are folks who want better light and engineered lighting but want it at reasonable cost.

Maybe it's time to check these jobs, to look them over, consider price ranges and possibly practical fixtures and necessary wiring and remodeling changes.

Maybe it's time to get ready for action.

Sincerely,

A. F. Wakefield



The Wakefield GRENADIER . . . helps modernize with a minimum of wiring changes

How Wakefield can help your lighting department

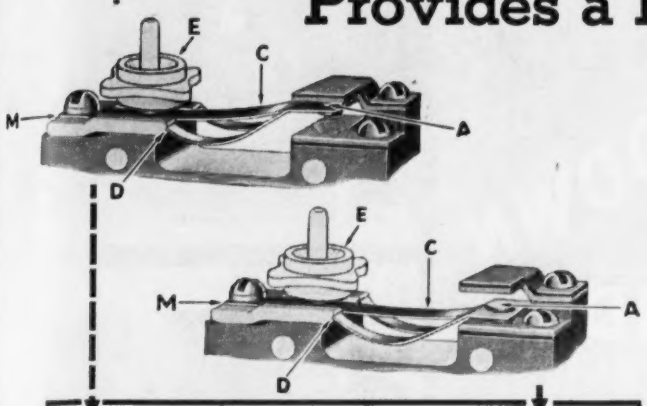
Wakefield lighting units are engineered for efficient performance and pleasing overall light. But that's only the beginning on a good lighting job. This is why Wakefield is always ready to work with you and your lighting section for planned lighting installations. And in producing them for today's "essential" buyers, one effective help is the GRENADIER. It provides plenty of light down on work, as well as pleasing light upward to guard eyes from dark ceilings. Write for details.

Wakefield

THE F. W. WAKEFIELD BRASS COMPANY • VERMILION, OHIO

Why MICRO SWITCH

Provides a Long Snap-Action Life



Micro Switch Operating Principle

The operating principle of the Micro Switch as illustrated here is simple and fundamentally correct. The long member of the one-piece spring "C" is supported as a cantilever at "M". The two shorter compression members of the spring rest in specially shaped (patented) V's. When the plunger "E" deforms the long tension member, the cantilever force overcomes the vertical force supplied by the compression members and the free end of the spring "A" snaps the contact from one stop to the other with lightning-fast speed. Snap action in the reverse direction occurs when the deformation of the tension members of the spring by plunger "E" is removed.

This one-piece beryllium copper spring is heat treated to provide the high fatigue resistance necessary to insure a minimum of 5,000,000 trouble-free mechanical operations, at full overtravel.

The rivet type contact is of superfine silver 99.95% pure.

The operating plunger is a highly polished, hard, stainless steel pin molded into an accurate Bakelite head. This head is so shaped that it cannot rotate, hence bears on the switch spring at the same point through millions of operations.

Micro Switch provides lightning-fast, snap-action control of electric circuits with reliable and positive operation accurately repeated over millions of cycles.

This performance is made possible by use of the unique, field tested, and proven operating principles of the Micro Switch. The snap motion of the Micro Switch contact is in the same direction as that of the operating plunger. There are no reverse bends in the Micro Switch spring, and there is no life-limiting "oil can" action.

The experience of electrical engineers with millions of Micro Switches in a great variety of applications has shown performance ability and operating characteristics never before found in snap-action switches.

Its small size, its high electrical rating, its ability to operate satisfactorily for millions of operations on minute movement and force differentials, its availability in various types of housings and a wide range of actuators . . . have made Micro Switch the choice of design engineers for precise operation of many types of plant equipment.

Micro Switch Handbook-Catalog No. 60 will give you complete details as to electrical characteristics, construction, applications and dimensions. If you happen to be specializing in aircraft equipment, also send for Handbook-Catalog No. 70.

The basic Micro Switch is a thumb-size, feather-light, plastic enclosed, precision, snap-action switch, Underwriters' listed and rated at 1200 V. A., at 125 to 460 volts a-c. Capacity on d-c depends on load characteristics. Accurate repeat performance is experienced over millions of operations. Wide variety of basic switches and actuators meets requirements varying from high vibration resistance to sensitivity of operating force and motion as low as 2/1000 ounce-inches. Many types of metal housings are available.

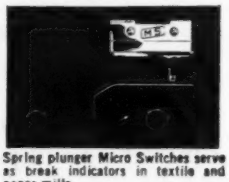
© 1944

HUNDREDS OF SPOTS FOR MICRO SWITCHES

An explosion-proof Micro Switch is used with a spray gun to cut off the ventilating system of the spray booth automatically when the gun is hung up.

Micro Switches are used as safety switches on high tension cabinet doors. A normally open switch breaks circuit as door is opened.

Two Micro Switches with spring type plungers are used to insure correct position of material in jigs and fixtures.



Spring plunger Micro Switches serve as break indicators in textile and paper mills.

MICRO MS SWITCH

TRADE MARK

A DIVISION OF FIRST INDUSTRIAL CORPORATION

FREEPORT, ILL., U.S.A., Sales Offices in New York, Chicago, Cleveland, Los Angeles, Boston, Dallas, Portland, (Ore.)

. . . . USES UNLIMITED

"Uses Unlimited"—a dramatic talking motion picture of Micro Switches, in color, is available to industrial groups, training classes, schools and colleges, through Y.M.C.A. Motion Picture Bureau, New York, Chicago, San Francisco. Size: 16 mm. Length: 40 minutes. Write us for details.

Two stars have been added to our "E" flag as further recognition to the men and women of Micro Switch for maintaining our war production standards.

Let's All Back the Attack—Buy Extra War Bonds

UPKEEP GOES DOWN with these UNDERGROUND CABLEWAYS

These 5 advantages of TRANSITE DUCTS assure low maintenance

1. *Permanently smooth bore*... long cable pulls and replacements are made easy. Danger of damage to cables is minimized.

2. *Easily and quickly installed*... long, lightweight lengths and simple assembly method assure rapid, economical installation.

3. *Inorganic*... made of asbestos and cement compressed under great pressure. This provides permanence and strength... makes these ducts immune to rust and rot.

4. *Immune to electrolysis*... being entirely inorganic and non-metallic, Johns-Manville Transite Ducts are not affected by electrolysis or galvanic action.

5. *Incombustible*... won't contribute to the formation of dangerous smoke, gases, or fumes. If burnouts do occur, these inorganic ducts provide maximum protection to adjacent cables and permit easy removal of damaged conductor.

For complete details on J-M Transite Ducts, write for Data Book DS-410, Johns-Manville, 22 East 40th Street, New York, N. Y.

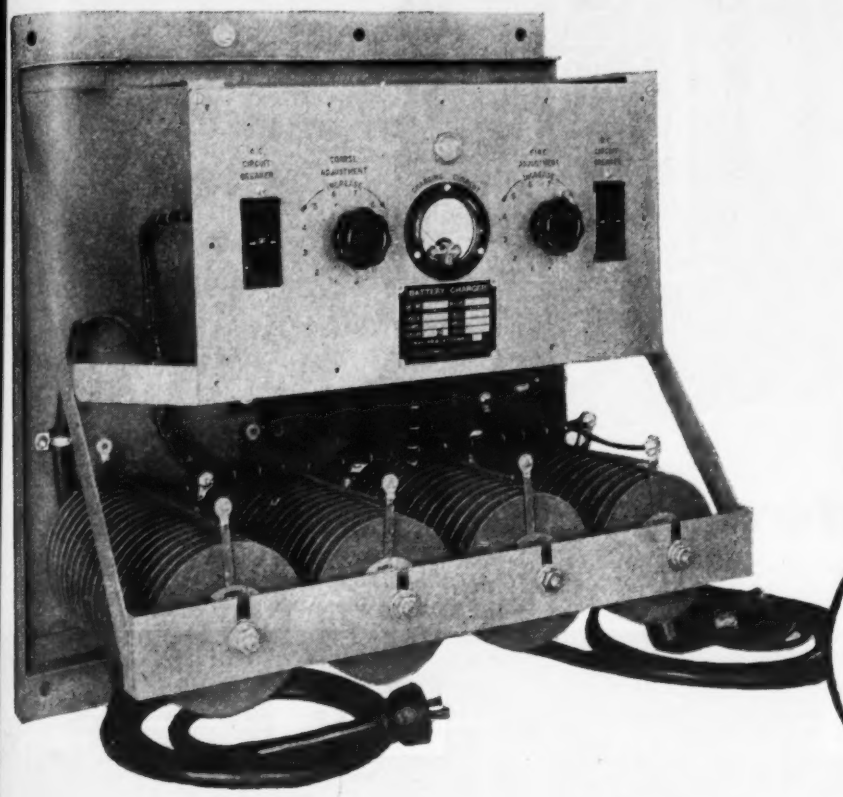
TRANSITE KORDUCT *above*—for installation in concrete. Thinner-walled but otherwise identical with Conduit.

TRANSITE CONDUIT—for exposed work and for use underground without a concrete encasement.

Johns-Manville **TRANSITE DUCTS**

JM PRODUCTS

This New *LOW RIPPLE* D C Power Supply is a Trim, Businesslike Job!



Close-up of the Federal Telephone and Radio Corporation FTR-3106-S combination battery charger and DC power supply shows the simplicity and neatness of internal wiring, protected by Natvar Grade A-1 Tubing.

Federal's new FTR-3106-S is flexible. Used as a power supply, it will furnish direct current from 5 to 80 volts in 121 steps, at 12 amperes, maximum. As a battery charger it will handle from 1 to 24 two-volt storage cells at a maximum current of 12 amperes.

Selenium Rectifiers — pioneered by Federal — provide the efficient, dependable means of converting single phase AC power to DC power. Conservative design which eliminates the need for fans or other moving parts, plus heavy overload capacity, along with the wide voltage range makes it suitable for a variety of laboratory and experimental work, as well as a rugged source of rectified DC for production equipment.

Natvar flexible tubing is used to protect the wiring of FTR-3106-S because of its high dielectric and mechanical strength, and because of its high uniformity.

What are your insulation requirements? Write, wire or phone us for deliveries, either from stocks located near you or from our own.

Natvar

- Varnished cambric — straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished cellulose acetate
- Varnished special rayon
- Varnished Fiberglas cloth
- Varnished papers
- Varnished tubings and sleeving
- Varnished identification markers
- Lacquered tubings and sleevings
- Extruded vinyl tubing
- Extruded vinyl identification markers

Write for Catalog No. 20

4-NVP-2

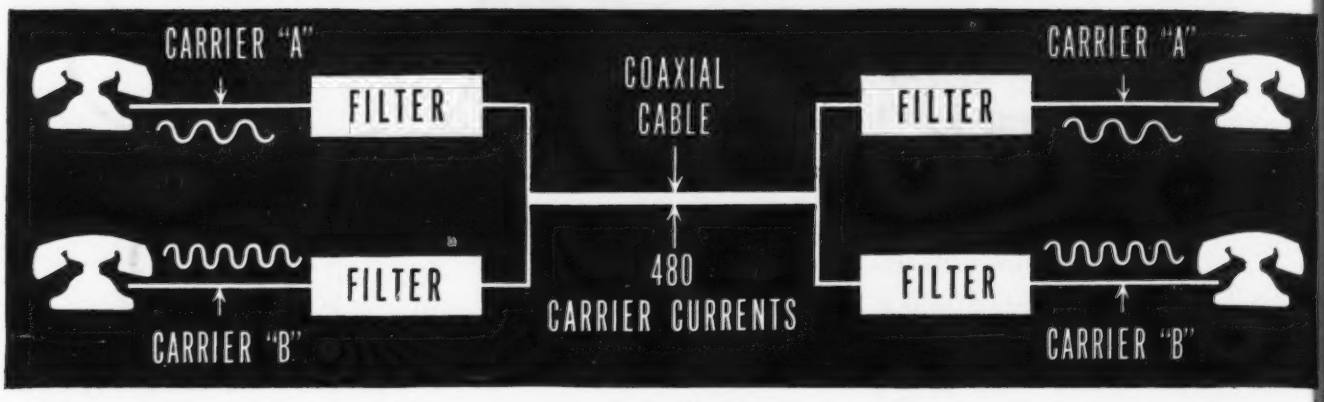
THE NATIONAL VARNISHED PRODUCTS Corporation

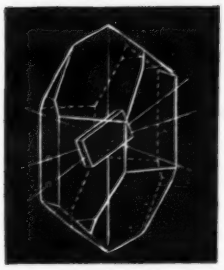
TELEPHONE RAHWAY 7-2171

CABLE ADDRESS NATVAR: RAHWAY, N. J.

221 RANDOLPH AVENUE ★ WOODBRIDGE NEW JERSEY

Crystal gateways for your voice





Four hundred and eighty telephone conversations over a coaxial cable was one of the last peacetime achievements of communication research in Bell Telephone Laboratories. In this multi-channel telephone system, each conversation is transported by its own high-frequency carrier current. At each end of the line are crystal gateways; each opens in response to its own particular "carrier" with the message it transports. In telephone terminology, these gateways are filters.

The ultra-selective characteristic of these filters is made possible by piezo-electric quartz plates, cut in a special manner from the mother crystal, and mounted in vacuum. Each set of plates is precisely adjusted so that the filter responds only to the frequency of its assigned channel, rejecting all others. In the coaxial terminal equipment, such crystal gates sort out messages for delivery to their four hundred and eighty individual destinations.

In recent years, Bell Telephone Laboratories research has provided the Armed Forces with many types of electrical equipment in which frequency is controlled by quartz crystals. Notable is the tank radio set which enables a tank crew to communicate over any one of 80 different transmission frequency channels by simply plugging in the appropriate crystal. The future holds rich possibilities for the use of quartz crystals in Bell System telephone service.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for our Armed Forces at war and for continued improvements and economies in telephone service.

10 types of prints instead of 1

when you use OZALID

1. Black-Line
2. Blue-Line
3. Red-Line
4. Dryphoto
5. Sepia-Intermediate
6. Transblack Intermediate
7. Transparent Cloth
8. Transparent Foil
9. Opaque Cloth
10. Chartfilm

Ten Types of Prints . . . and no end to the uses you'll find for them in the drafting room . . . and in departments where you never thought of using prints before.

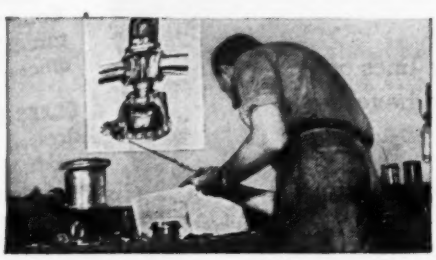
OZALID offers this versatility because it is a uniquely different process requiring only two steps—Exposure and Dry Development—to reproduce your engineering drawings or other originals.

These two steps are performed in as little as 17 seconds by an OZALID WHITE-PRINT MACHINE . . . and if you have a satisfactory printer you need only add an OZALID DRY DEVELOPER to make *all* ten types of prints.

It's inexpensive to adopt OZALID . . . and you count improvements right away in economy, speed and versatility.

10 instead of 1 means increased versatility for all departments

In the Drafting Room, OZALID prints are always easier to read, check and make notations on. And when changes in design are necessary, OZALID intermediates (transparent prints) of original drawings save valuable time. A) Obsolete lines are quickly removed with OZALID CORRECTOR FLUID. B) NEW DESIGN is drawn in. C) OZALID INTERMEDIATE is used to produce desired number of "work prints."



In the Shop, efficiency is increased by assigning identifying colors to prints of different operations—distinguishing checked from unchecked prints, etc. OZALID OPAQUE CLOTH is used when exceptionally durable prints are desired, and OZALID CHARTFILM, which can be readily cleaned and requires no protective covering, is used for instrument panels, wiring diagrams, etc. Also, OZALID DRY PHOTOS of any photographic subject may be employed.

In the Office, anything drawn, typed, printed or photographed on translucent material can be reproduced in seconds with OZALID.

For example: The Prudential Life Insurance Company of America uses OZALID to reproduce applications for Industrial Insurance; Pratt Institute—to copy student records; Alpha Music—to reproduce arrangements for CBS and other radio programs.

OZALID

See *All* 10 Types of Ozalid Prints and Learn the Whole Story. Write for Free Catalogue today.

DIVISION OF GENERAL ANILINE AND FILM CORPORATION • JOHNSON CITY, N. Y.

OZALID IN CANADA—HUGHES-OWENS CO., LTD., MONTREAL

LOOK IT UP IN E-B-R!

● Each issue of E-B-R is as up-to-date as the New Year itself. Every bit of data in the Directory Section has been checked and revised. In the manufacturers Briefalog* section, every bit of product information has been brought up-to-the-minute by the manufacturers themselves. E-B-R is the *only* annual product reference book published in, and for, the electrical industry.

It will pay you to "look it up *first* in E-B-R" if:

- You need to know *who* makes *what*
- You know the trade name, but not the Company name
- You want product data on the lines of any of the 357 manufacturers who have Briefalogs* in E-B-R
- You are looking for new sources of supply
- You want the address of the home office or the nearest branch office of a manufacturer
- You need to know who makes an unusual or infrequently used product.

IF ITS ELECTRICAL —LOOK IT UP FIRST IN E-B-R

Now more complete than ever before, your 1945 Electrical Buyers Reference gives you:

MANUFACTURERS BRIEFALOG SECTION—Condensed catalogs of 357 manufacturers. Product specifications, branch offices, warehouses, etc.

CLASSIFIED DIRECTORY—Company addresses and trade names, arranged by product. Extensive cross-reference to help you find the electrical and allied products made by more than 3,500 manufacturers.

INDEX OF TRADE & COMPANY NAMES—Complete with addresses. Starting with only a trade name or a company name, you can quickly locate the product data you need.

E-B-R *is your electrical reference, designed to help solve your specifying and rquisitioning problems. Use it to save time and money.*

*Briefalog—E-B-R's own original version of modern condensed cataloging.

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330 WEST 42nd STREET
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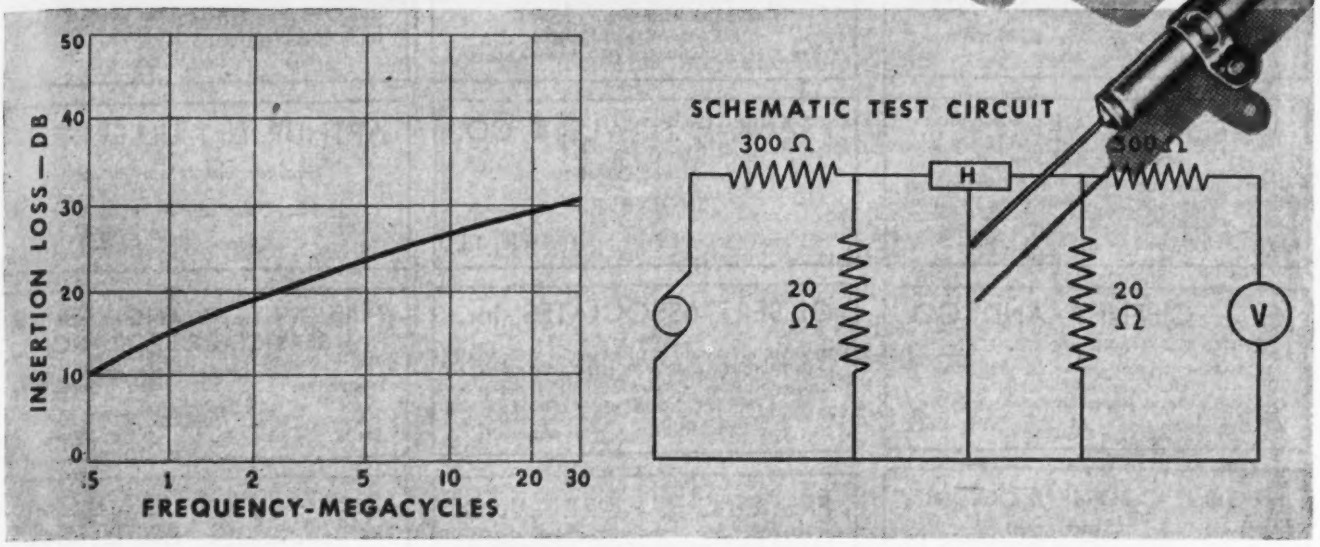
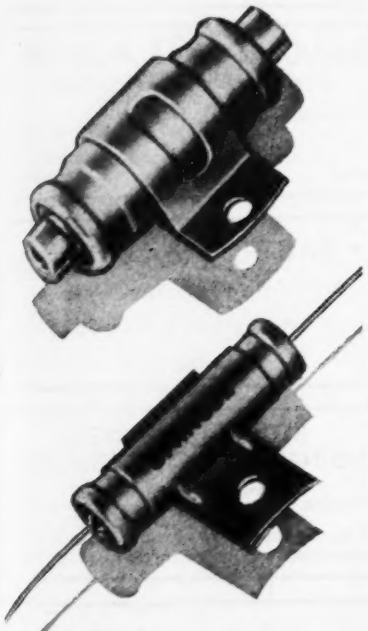
ELECTRICAL BUYERS REFERENCE E-B-R

SPRAGUE HYPASS CAPACITORS



Curve showing insertion loss of a Sprague HYPASS Capacitor.



The Solution to "WHAT TO DO WITH ANTI-RESONANT FREQUENCIES?"

Conventional methods of getting rid of vibrator "hash" usually call for the use of a by-pass capacitor, shunted by a mica capacitor. This system, however, has at least one anti-resonant frequency. Of course the engineer juggles his constants so that this anti-resonant frequency comes where it causes the least trouble—BUT, in today's all-wave devices, there just isn't any such place!

The New Sprague Method is simply to utilize the Sprague HYPASS Capacitor. Technically, this is a 3-terminal network which, at low frequencies, "looks" like a capacitor in respect to its capacity, voltage rating, and size. At high frequencies—well, the above diagram tells the story. Although accurate measurements of their performance at the very high end of the spectrum are difficult to obtain as yet, qualitative indications show that HYPASS units do the job at 100 megacycles and more—so much so that, if you have a "hash" problem, we'd welcome an opportunity to stack them against it.

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Electric & Manufacturing Co.

(Additional Employment Advertising on page 222)

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	HP	Make	Type	Volts	Speed
2—	1250	G.E.	MPC	550	160
1—	1200	Whse.	Compen.	550	600/720
1—	800	G.E.	MPC	660	600
1—	700	G.E.	MPC	250	200/360
2—	625	G.E.	MPC	500	160
1—	600	G.E.	MPC	600	650/900
1—	500	G.E.	MPC	230	900
1—	500	Whse.	Compen.	250	800/720
1—	350	G.E.	MPC	220	450
1—	300	G.E.	MPC	230	275/550
1—	250	Al. Ch.		230	525
2—	200	Whse.		230.	400
1—	175	Whse.	SK	250	150/525
1—	150	G.E.	MPC	230	250/450
2—	130	Cr. Wh.	CMC-65H	550	1200
2—	125	G.E.	CO-	230	625
1—	100	G.E.	LC-50	230	1200
1—	100	G.E.	MPC	230	225/450
1—	100	G.E.	RC-38	230	600
1—	75/100	Whse.	SK-183	230	450/900
1—	75	G.E.	LC	230	500/1000
2—	75	Whse.	SK-183	230	560/1100
1—	60	Al. Ch.	E-131	115	1750
1—	60	El. Dy.	258	230	424/1050
2—	50/60	Cr. Wh.	65H	230	500/1000
1—	50	Cr. Wh.	CMC-81H	230	300/900
1—	50	G.E.	RC-19	230	400/1200
2—	40	El. Dy.	30S	230	300/900

TRANSFORMERS

KVA		Make	PH	Type	Voltage
3—	1667	Pitts	1	OISC	13200x2300
1—	1050	G.E.	3	WCTH	11000x445
10—	525	G.E.	1	HJDD	2300x445
4—	500	Pitts.	1	OISC	13200x2300
2—	333	Moloney	1	C-OISC	22000/11000x2300/575
2—	333	Whse.	1	OISC	2300x460
2—	333	Pitts.	1	OISC	2400x220
1—	300	G.E.	1	H-RP	13200x575/1150/2300
1—	300	Pitts.	3	ODSC	4150x208/120
3—	200	G.E.	1	H-IDD	6400x115/460

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3 ph. 60 cycle

1—1500 KW GE 275 V. Gen. d.c. to 2100 HP 2300 V.
1—1000 KW G.E. 250 V. DC to 1400 HP 2300 V.
1—1000 KW Whse. 600 V. Gen. d.c. to 2000 Kva—2200 V.
1—750 KW Whse. 275 V. Gen. d.c. to 1100 HP 2300 V.
1—750 KW G.E. 250 V. Gen. d.c. to 1080 HP 2300/4150 V.
1—500 KW GE 600 V. DC Gen. d.c. to 700 HP—2200/13200 V. Syn. Motor with Exciter.
1—400 KW GE 250/275 V. Gen. d.c. to 650 HP 2300 V.
1—350 KW GE 220 V. AC Gen. d.c. to 500 HP 250 V. DC motor.
1—200 KW GE 125 V. Gen. DC to 300 HP—440 V.
1—150 KW Ideal 3 unit with 250 HP, 440 V. Syn. motor and 2—75 KW, 125 V. generators.
1—75 KW GE 125 V. Gen. to 120 HP IK 400/2300.
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1—500 KW, Whse. 625 Kva., 440 V., 3 ph., 60 cy., 3600 RPM with Parsons 145/175 lb. condensing turbine complete with jet condenser and accessories.

ROTARY CONVERTERS

60 Cycle

	KW	Make	Speed	D.C. Volt	Trans. Volts
1—	1500	Whse.	720	600	2300
1—	1500	Whse.	600	600	11500
1—	1250	G.E.	720	250	2300
1—	1000	G.E.	900	600	13200
1—	1000	Whse.	900	600	11000
1—	750	G.E.	1200	600	2300
1—	750	Whse.	720	250	6600/2300
1—	500	Whse.	1200	600	13200/2300
1—	375	G.E.	1200	250	6600/2300
2—	300	G.E.	1200	600	2300

25 cycle

2—	1500	G.E.	500	225/275	13200/6600
1—	500	G.E.	750	225/275	13200/6600

All units can be furnished with AC and DC controls.

A. C. MOTORS

3 ph. 60 cycle

Synchronous

	HP	Make	Type	Volts	Speed
2—	2100	G.E.	ATI	2300/4600	514
1—	600	Al. Ch.		2200	720
2—	200	G.E.	TS-7644	2300	600
1—	75	G.E.	TS-7556	220/440	600

Slip Ring

1—	1200	Cr.-Wh.	801-Q	220	237
1—	800	Al. Ch.		440	885
1—	600	G.E.	MT	550	220
1—	600	Cr. Wh.	131-AQ	2300	507
1—	500	Al. Ch.	ANY-36	2300	590
1—	450	Whse.	CW	2200	875
1—	400	Al. Ch.		2300	505
1—	400	G.E.	IP	2200	252
1—	350	G.E.	MT-442y	550	390
1—	250	G.E.	MT	4000/2300	257
2—	250	Whse.	CW	2300	438
1—	100	G.E.	IM	220	1750
1—	100	G.E.	IM	2200	575

Squirrel Cage

1—	300	Whse.	CS	550	580
1—	300	G.E.	IK-17	440	900
1—	200	G.E.	IK	550	580
1—	175/112	G.E.	IK	440	900/720
1—	150	Whse.	CS	550	400
1—	100	Whse.	CS	2200	

SYNCHRONOUS CONDENSERS

1—	5000	Whse.		2300/4150	900
1—	3000	Al. Ch.		2300	900
1—	2000	G.E.	ATI	600	900
1—	2000	Whse.		2400	720
1—	1000	G.E.	ATI	2200/3800	900
1—	750	G.E.	ATI	220/440	900

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3—Motor Driven Centrifugal Pumps.
2—300 G.P.M. Platt Iron Wks. Size 4, 334 Ft. Hd. with 50 H.P. Ft. Wayne 2300 V, 3 Phase Motors.
1—600 G.P.M. De Laval Cent. Pump, with 75 H.P. G.E. 3 Phase, 2300 V, 60 Cycle, Slip Ring Motor and Controller. Grid Resistance, etc.

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1— 75 KW, 125 volt, General Electric, squirrel cage.
1— 15 KW, 250 volt, General Electric, squirrel cage.
1—6½ KW, 125 volt General Electric, squirrel cage.

MOTORS—3 PHASE 60 CYCLE

1—500 H.P., 900 RPM, 440 volt, Lincoln slip ring.
1—400 H.P., 220 volt, 1200 RPM, Westinghouse squirrel cage.
1—350 H.P., 300 RPM, 400 volt, General Electric slip ring.
1—250 H.P., 600 RPM, 2200 volt, General Electric slip ring.
1—200 H.P., 1800 RPM, 220 volt, General Electric slip ring.
1—200 H.P., 600 RPM, 550 volt, Westinghouse slip ring.
1—200 H.P., 600 RPM, 440 volt, Crocker-Wheeler slip ring.
1—150 H.P., 1800 RPM, 440 volt, General Electric squirrel cage.
2—150 H.P., 1800 RPM, 220 volt, Westinghouse slip ring.
1—150 H.P., 400 RPM, 440 volt, General Electric squirrel cage.
3—100 H.P., 720 RPM, 440 volt, General Electric slip ring.
1—100 H.P., 600 RPM, 2200 volt, General Electric slip ring.
1—100 H.P., 450 RPM, 440 volt, General Electric squirrel cage.
1—100 H.P. 1800 R.P.M., 440 volt, G. E. squirrel cage.
1—85 H.P. 900 R.P.M., 220 volt, G. E. synchronous.
2—75 H.P. 900 R.P.M., 220 volt, G. E. slipring.

Gasoline Driven Generator Sets
2—25 KW, 125 volt, direct current
130 KW, 125 volt, direct current

1— 90 H.P., 400 RPM, 650 volt, Crocker-Wheeler squirrel cage.
1— 75 H. P., 900 RPM, 4000 volt, Electric Machinery synchronous.
1— 75 H.P., 720 RPM, 440 volt, Westinghouse slip ring.
1— 60 H.P., 1200 RPM, 440 volt, General Electric slip ring.
1— 50 H.P. 1200 R.P.M. General Electric, Squirrel Cage.
1— 50 H.P., 900 RPM, 440 volt, General Electric slip ring.

MOTORS—D.C. 230 VOLTS

2—450 HP, 400 RPM, G.E.
1—250 HP, 760 RPM, Electro Dynamic
1—150 HP, 750 RPM, Electro Dynamic.
1—150 HP, 500 RPM, General Electric, MPC.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1— 50 HP, 750 RPM, Westinghouse, type SK.
1— 50 HP, 700 RPM, Crocker-Wheeler.
1— 40 HP, 775 RPM, Westinghouse.

TRANSFORMERS

2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—150 KVA, G.E., 33,000 2300/4000 Y.
3—100 KVA, Westinghouse, 11,430/250 volts.
1—100 KVA, Pittsburgh, 1375/2750-110/220 volts.
3—100 KVA, Westinghouse, 13200 250 volts.
3—75 KVA, G.E., 13500-7500/440 volts.
1—75 KVA, G.E., 3 phase, 4156Y-120/208Y.
2—50 KVA, Phgh., 7500/15,000 volts-110/220 volts.
3—50 KVA, Pittsburgh, 2200-220/110.
3—37½ KVA, General Electric, 2200/220/440
1—25 KVA, G.E., 220/110-20/110 volts.
3—25 K.V.A. G. E. 2200—220/110.
2—15 KVA, G.E., 2300-115/230 volts.

MOTORS—VARIABLE SPEED 230 VOLTS

1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—35 HP, 500/1500 RPM, Westinghouse.
1—30 HP, 225/900 RPM, Crocker Wheeler.
1—30 HP, 400/1200 RPM, General Electric.
2—25 HP, 300/990 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
2—11½ HP, 500/1500 RPM, Westinghouse, type, SK.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

INSTRUMENTS

25—Westinghouse type U recording ammeters with split core CT.
25—Westinghouse type U recording voltmeters.

TURBO GENERATORS

600 KW, Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 430 volt, bleeder.
1—375 KVA, Westinghouse, non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 volt, cond.
1—300 KW, G.E., 3 ph., 60 cy., 220 volt, cond.

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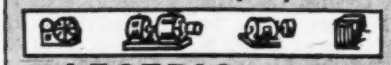
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Chicago, 8, Illinois

New "SEARCHLIGHT" Advertisements
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★ These companies have supplied additional buying information on their products in the 1945 edition of the Electrical Buyers' Reference

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better switchgear TOMORROW—

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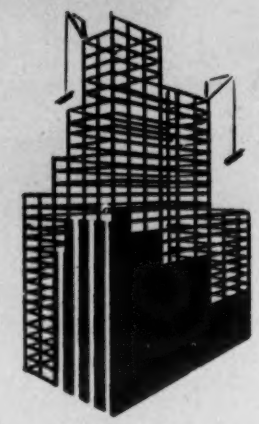
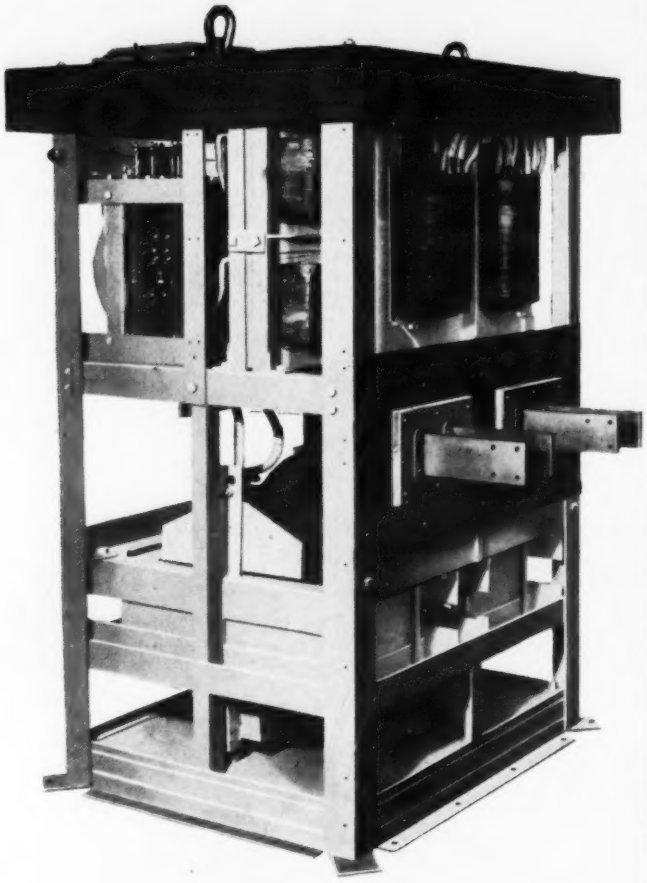
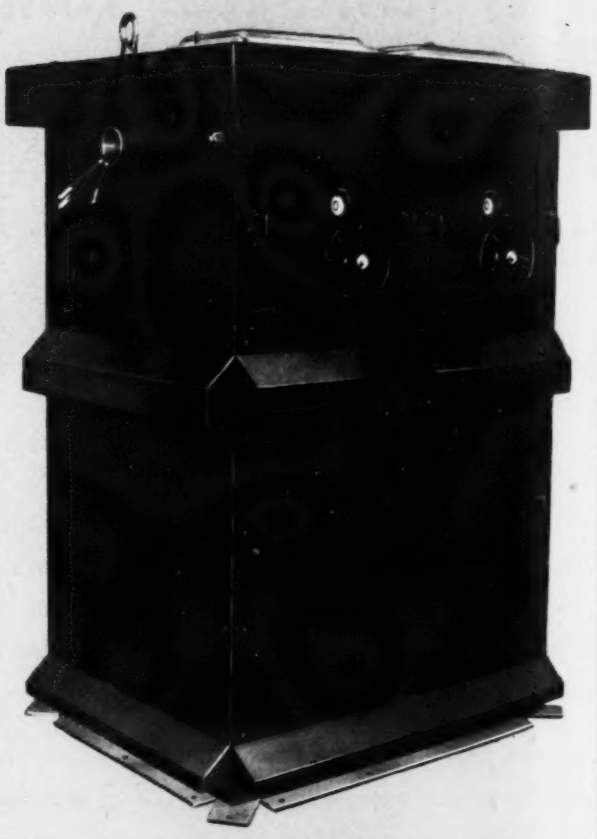
SKYSCRAPER-TYPE CONSTRUCTION

insures rigidity, strength and long life of large Kuhlman Dry Type Transformers





From its sturdy steel frame to its unique coil construction, a Kuhlman Dry Type Transformer is built to easily withstand the stress and strain of constant heavy loads. Heavy steel angle-iron frame braces the entire unit against vibration and distortion. Glass insulated magnet wire insures temperature rise protection. Large and numerous air ducts give proper radiating efficiency. Heavy-gauge steel case effectively encloses operating parts as well as strengthens the unit.



Above Secondary side of core and coil assembly of a 200 KVA, 3 phase/2 phase, 60 cycle Kuhlman Dry Type Transformer showing bus bars for low voltage, 2 phase, secondary connections.

Right: Complete assembly of same transformer built especially for use with Detroit Rocking Electric Melting Furnaces. This unit is equipped for manual tap changing under load Note the convenient hand wheels with position indicators for this purpose.

Write for further information. Other Kuhlman products include Power and Distribution transformers of Saf-T-Kuhl, C.S.P and O.I.S.C. types and Detroit Electric Melting Furnaces.

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